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NAVAL POSTGRADUATE SCHOOL
Monterey, California

USERS GUIDE:
ADVANCED REACTIVE ELECTRONIC SIMULATION (ARES)
Version 1.12

by

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March 2001

Prepared for: Applied Physics Laboratory, Johns Hopkins University

NAVAL POSTGRADUATE SCHOOL
Monterey, California

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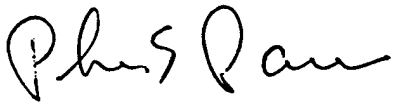

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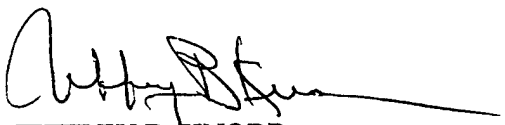

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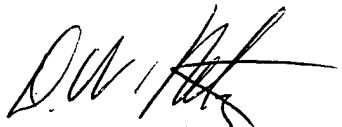

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13. ABSTRACT (Maximum 200 words)
This Users Guide is for the Advanced Reactive Electronic Warfare Simulation (ARES) Version 1.12, created at the Naval Research Laboratory (NRL) under a project sponsored by the Office of Naval Research (ONR) titled *Distributed and Networked C2W Technology* (FY98-FY00). The simulation is used to determine the optimum distributed C2W/EA configuration of assets including placement of sensors and system selection (jammer or receiver or both) for important mission scenarios leading to a better understanding of the minimum requirements for suppression of enemy air defense operations. ARES is a pulse level simulation that models the complex interaction of multiple radar systems being acted upon by multiple AEA aircraft, considering target aircraft radar cross section (RCS) and altitude, terrain masking effects, both standoff jamming and self protection jamming effects, and network connection effect. Its features include an object-oriented scenario workbook allowing the users to build a battlefield scenario and a search procedure based on a genetic algorithm (GA) for optimizing configurations of what the core and peripheral components of the AEA architecture should be. ARES is available in two forms: Graphical User Interface (GUI) and parallel. ARES' GUI runs on a personal computer (PC) and its primary application is for setting up scenarios and post processing. ARES' parallel version runs over a cluster of Intel based Linux machines with Message-Passing Interface (MPI) and provides capability to execute multiple iterations simultaneously, significantly reducing processing time for complex scenarios.

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I. INTRODUCTION

Advanced Reactive Electronic Warfare Simulation (ARES) Version 1.12 was created at the Naval Research Laboratory (NRL) under a project sponsored by the Office of Naval Research (ONR) titled *Distributed and Networked C2W Technology* (FY98-FY00). The simulation is used to determine the optimum command and control warfare/electronic attack (C2W/EA) configurations of assets including placement of platforms and system selection (jammer or receiver or both) for important mission scenarios leading to a better understanding of the minimum requirements for suppression of enemy air defense (SEAD) operations. ARES is currently being applied to the Analysis of Alternatives (AoA) in order to assist in generating candidate multi-component alternatives.

Written in C++, ARES is a pulse level simulation that models the complex interaction of multiple radar systems being acted upon by multiple airborne electronic attack (AEA) aircraft, considering target aircraft radar cross section (RCS) and altitude, terrain masking effects, both standoff jamming and self protection jamming effects, and network connection effect. Its features include an object-oriented scenario workbook allowing the users to build a battlefield scenario and a search procedure based on a genetic algorithms (GA) for optimizing configurations of what the core and peripheral components of the AEA architecture should be [Ref. 1 and 2].

Inputs to ARES consist of an order of battle that denotes the locations of the players to be modeled, parametric data representing the operating characteristic of those players, network connections between those players, and run-time analysis parameters

supplied by the users. ARES is designed to work with the Multi-Service Force Deployment (MSFD) threat laydown, although non-MSFD scenarios may also be created. If using the MSFD, the laydown file may be imported directly into ARES, where it may be filtered to reduce the large number of objects to only those that are of interest. The imported objects are initially static, possessing a geographical location and little else. It is then up to the users to create the systems and signature attributes that will make these static players active.

As illustrated in Figure 1-1, an ARES player is based on a single model that can be comprised of various systems. The difference between a player and a model is the difference between the concrete and the abstract. For example, EA-6B ICAP III is a model. EA-6B tail number ABC at location XYZ is a player. When a player assumes the role of a particular model, it receives all of the parametric data defined by the model. [Ref. 1]

In ARES, systems that combine to define a model are built out of multiple lower level components and can take the form of a radar, an ESM system, or a jammer. For the radar systems, the lower level components are as shown in Figure 1-2. The ESM systems have the same components as the radar systems minus the transmitter, while the jammer systems consist of only the transmitter.

ARES is available in two forms: Graphical User Interface (GUI) and parallel. ARES' GUI runs on a personal computer (PC) and its primary application is for setting up scenarios and post processing. ARES' parallel version runs over a cluster of Intel based Linux machines with Message-Passing Interface (MPI) and provides capability to

execute multiple iterations simultaneously, significantly reducing processing time for complex scenarios.

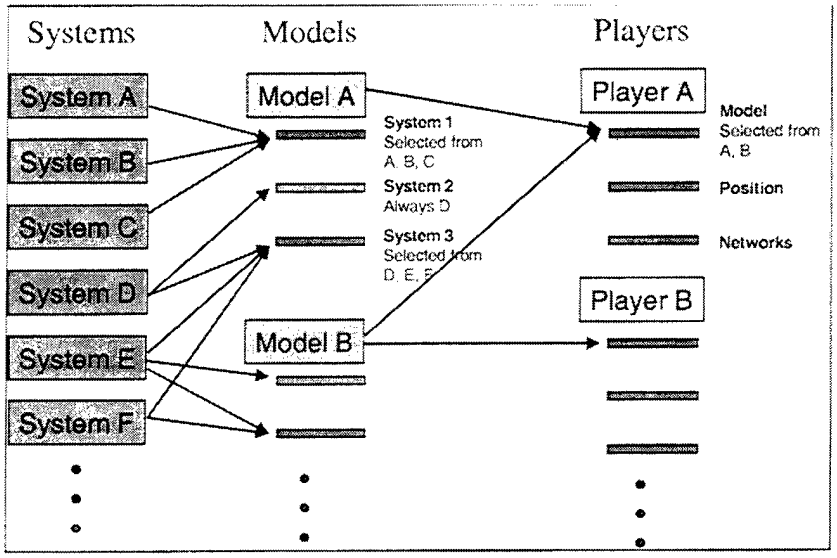

Figure 1-1. ARES Design Architecture. From Ref. 1.

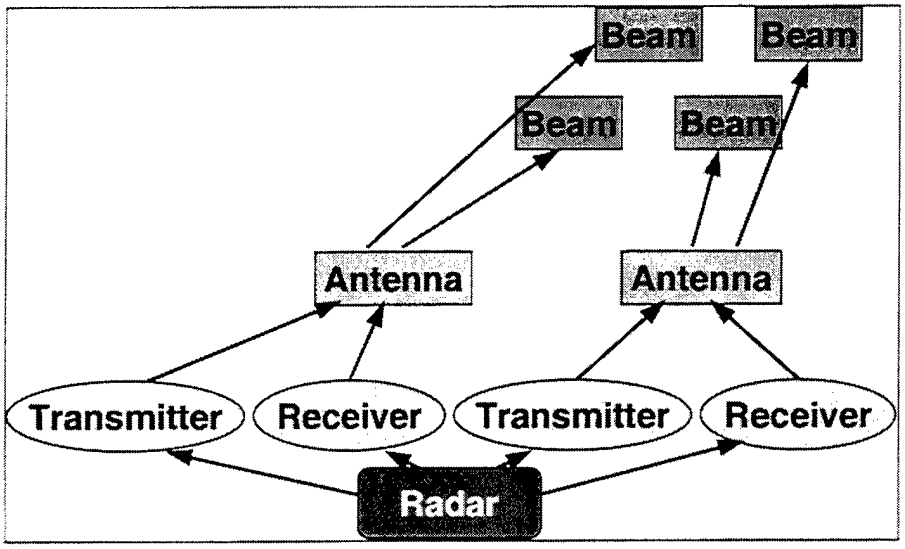

Figure 1-2. Radar System's Component. From Ref. 1.

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II. GETTING STARTED WITH ARES GUI

To effectively use ARES, the users must have some familiar with Windows NT operating system. This includes how to open and close Windows application, and how to use a mouse for selection.

A. HARDWARD AND SOFTWARE REQUIREMENTS

Using virtual memory, ARES with GUI is designed to run on any IBM™ compatible machine that will support Windows NT version 4.0 with Service Pack 3 or higher. However, execution times will vary greatly depending on the application and hardware. The platform running ARES GUI should, at a minimum, possess the following:

PROCESSOR	CLOCK SPEED	RAM	HDD CAPCITY	SCREEN RESOLUTION
PENTIUM III	500MHz	256Mbytes	2GBytes	1024 x 768, true color

Table 2-1. Minimum Hardware Requirement for ARES GUI

B. INSTALLATION

As with any Windows application, ARES is installed by running the provided Setup program and following the on-screen instructions. There are three types of installation that the users can choose from: typical, compact, and custom.

TYPICAL: Installs all components except for files needed to execute ARES in parallel over a network.

COMPACT: Installs all files except the parallel files and examples.

CUSTOM: Allows the users to customize the installation. Choose Custom if the users want to install the parallel files.

When software installation completes, ARES can be launched either from the Start menu, My Computer, or Windows Explorer. When ARES is first launch, a "Splash" screen is visible for few seconds, followed by ARES startup window, shown in Figure 2-1, where the users can open a new or existing scenario.

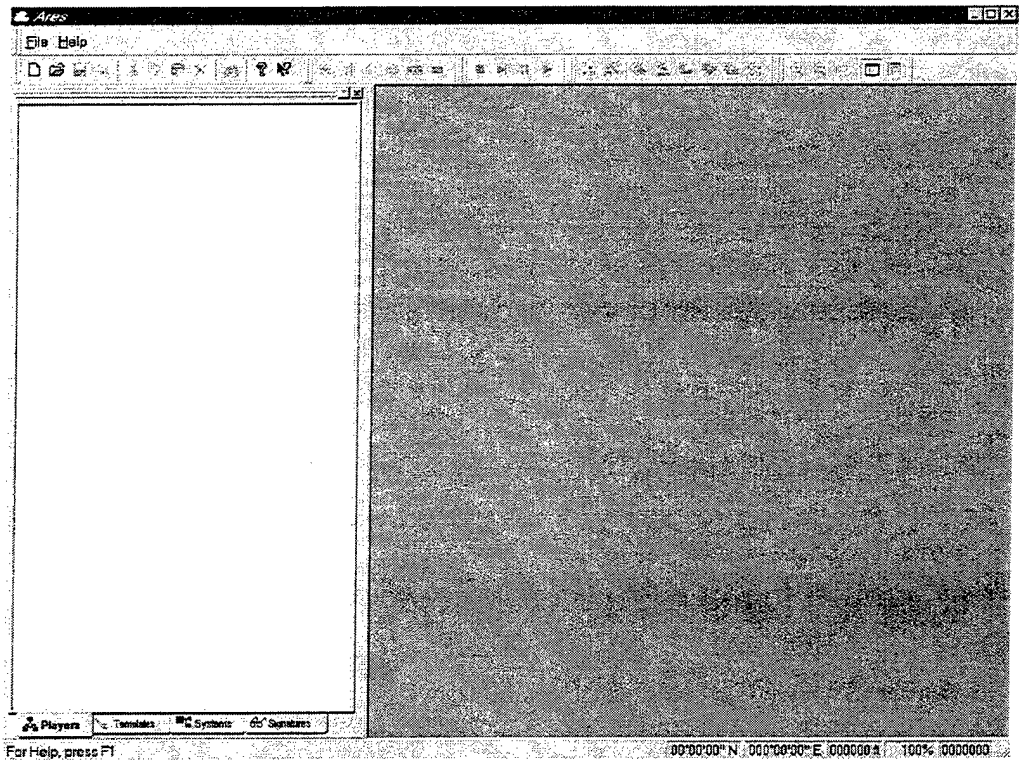

Figure 2-1. ARES Startup Screen

1. Opening Scenarios

To open an existing scenario, the users can select **Open** from the **File** drop-down menu or left-click the icon. In the file selection dialog box that appears, the users can browse to the directory where the desired document resides and select it by double clicking on the file name. Upon doing this, the users are presented with a window screen labeled with the document's name. This window is the ARES main window containing

the tools that the users work with to build, execute, and plot result for a scenario. Figure 2-2 is a look at ARES window as it appears with a sample file opened.

To open a file recently saved in ARES, the users can click on the name of the file from The Most Recently Used list. This list appears at the bottom of the **File** menu, just above the **Exit** selection. and contains the up to four names of the files that have been opened most recently in ARES.

2. Create New Scenarios

Creating a new scenario requires the users to either left-click the  button on the tool bar or choose **New** from the **File** menu. Upon doing this, ARES opens a fresh GUI window with a temporary name of "Ares1" as filename.

C. EXPLORING THE SCREEN

As illustrated in Figure 2-2, ARES main window typically consists of the following components:

1. Title Bar

Extended across the top of the window, the title bar displays the application and document title that the users are working on. Like any other title bar in Windows application, the users can click it to reposition the ARES window, or resize the window by grabbing any of the ARES window's edges. The three Application Control Buttons ARES window control icon found at the right end of the title bar allow the users to, from left to right, minimize, maximize/restore (toggle between ARES filling up the entire Windows Desktop, and floating the ARES window on the Desktop), and shut down ARES. Clicking on the Application icon at the far left of the title bar invokes a

drop-down menu, which simply duplicates the function of the Application Control Buttons.

2. Menu Bar

Located under the title bar, it contains a list of menu heading, with each main heading leading to a drop-down menu, described in Chapter III. The three Document Control Buttons at the right end of the menu bar allow the users to, from left to right, reduce the view window to an icon in the view window, maximize the view window to full screen size or returns view window to its last non-maximized position, or close the ARES. The icon to the left of File replicates the functions of the three Document Control Buttons via a drop-down menu.

3. Toolbar

Below the main Menu Bar is the Toolbars, containing shortcuts providing quick, one-click access to commonly used commands in the menus. Features of ARES toolbar buttons are described in Chapter IV.

4. Workspace

The workspace is the area of the main window where the users create, edit, execute, and analyze scenario. It consists of two split windows: view window to the right and control bar window to the left. There are three view windows in ARES: Edit, Execute, and Chart. Each view is linked to a different control bar and provides different functions, as described in Chapter V through XIV. By default, ARES automatically opens the document in Edit View window.

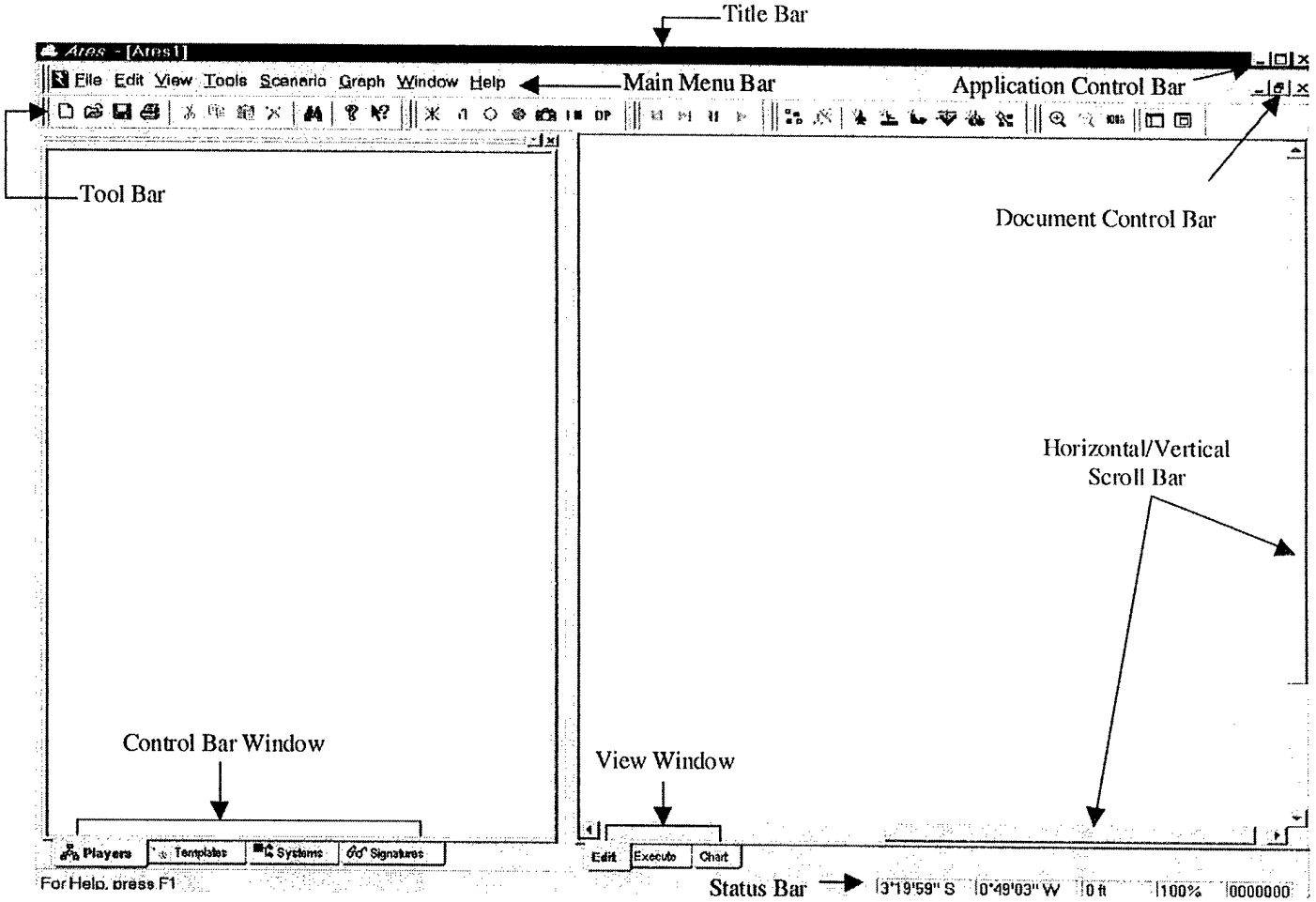

Figure 2-2. Sample of ARES Main Window

5. Status Bar

The status bar, which appears along the bottom of the window presents five panes of information. As described in Chapter VI, the information presented in these panes differs depending on whether there is an object currently selected in either the view window or in the Players tab of the associated control bar window. This bar is only active from the Edit view window.

6. Vertical/Horizontal Scroll Bar

Used to pan the current viewing window and view other areas of window that do not fit on the screen. Panning is useful when using a zoomed-in-view. At the end of each scroll bar, pointing in opposite direction, are scroll arrows. They point in the direction that the window moves over. Clicking the arrow with left mouse button moves the window a small amount in that direction. For more rapid scrolling, click and hold the mouse button down on the scroll arrow.

III. MAIN MENU BAR

ARES **Menu Bar** consists of eight headings as illustrated in Figure 3-1. Clicking on each heading pulls down a menu, with each of the sub-headings described in the following sections. Note that if a command is unavailable in the current view, it appears grayed out.

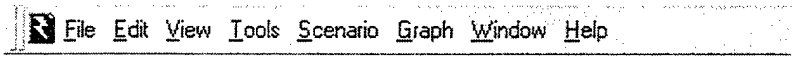

Figure 3-1. Main Menu Bar

A. FILE MENU COMMANDS

The **File** drop-down menu, as shown in Figure 3-2, contains commands necessary to invoke the standard I/O operations. The individual menu items are described below.

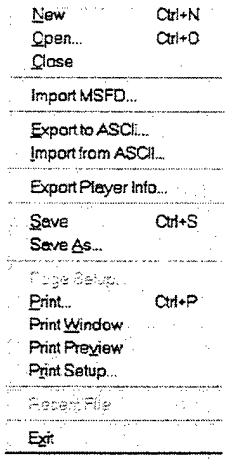

Figure 3-2. File Drop-Down Menu

New: Creates a new ".jam" document in ARES and assigns an incremented, temporary as the filename. This command can also be activated without accessing the drop-down menu by pressing Ctrl and N keys simultaneously on the keyboard.

Open: Calls a file selection dialog allowing the users to load an existing ARES (.jam) document in a new window. Multiple documents can be opened at once. The users can switch among the multiple open documents via the Window menu or document tabs. The uses can also invoke this command without accessing the drop-down menu by pressing Ctrl and O keys simultaneously on the keyboard.

Close: Closes all windows containing the active ARES ".jam" document and prompts the users to save changes to the document before closing it. If a document is closed without saving, all changes made since the last time the users saved it is lost.

Import MSFD: Imports a Multi-Service Force Deployment (MSFD) file into the active ARES document. Upon invocation of this command, the users are prompted to open an MSFD file (.msf). Once the file is selected, the users are warned to set a filter before opening the file (see Section E). Since MSFD files typically contain hundreds of thousands of objects, this is highly recommended.

The MSFD import function displays the objects according to their MSFD Unit Subordination Code in the Players pane of the Scenario Workbook.

Export to ASCII: Prompts the users for the name of an ASCII text file to write the scenario ".jam" file. This file may later be transferred to Linux cluster for parallel processing (see Appendix D).

Import from ASCII: Prompts the users for the name of an ASCII text file for loading. This file may be the scenario created with Linux cluster.

Export Player Info: Prompts the users for the names of an ASCII text file to extract the information of all players participating in the scenario. The extracted

information is intended to provide a general purpose ASCII listing of the scenario and includes sequence number, player name, player's position in latitude and longitude, sequence number of the command and control superior, Electronic Intelligence Notations (ELNOTs) of any emitters, and lethal range of any weapons.

Save: Saves the active document to its current name and directory. The users can also invoke this command without accessing the drop-down menu by pressing Ctrl and S keys simultaneously on the keyboard.

Save As: Calls a file selection dialog box allowing the users to save the active ".jam" document to a new name and directory.

Page Setup: Sets up the print layout for a graph in ARES Chart view window.

Print: Prints the content display of the current view window. This command also can be invoked without accessing the drop-down menu by pressing Ctrl and P keys simultaneously on the keyboard.

Print Window: Prints the viewable part of the map display in the Edit view window. This command is not accessible from the Execute and Chart view.

Print Preview: Displays the active document as it would appear when printed. When the users choose this command, the main window will be replaced with a print preview window in which one or two pages will be displayed in their printed format. The print preview toolbar offers the users options to view either one or two pages at a time; move back and forth through the document; zoom in and out of pages; and initiate a print job..

Print Setup: Presents a Print Setup dialog box where the users can select a printer and a printer connection.

Exit: Ends the ARES session and prompts the users to save documents with unsaved changes. Closing document can also be done by clicking on the right most Application Control Button.

B. EDIT MENU COMMANDS

The Edit menu, as shown in Figure 3-3, contains the functions necessary to modify/manipulate an object currently selected in either the view window or in the Players tab and locate an object on the tree structure displayed in Players tab. The individual menu items are described below.

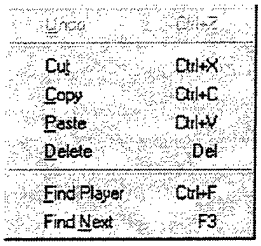

Figure 3-3. Edit Drop-Down Menu

Undo: Reverses the last editing action, if possible. This command also can be invoked without accessing the drop-down menu by pressing Ctrl and Z keys simultaneously on the keyboard.

Cut: Removes the currently selected object in either the view window or in the Players tab from the document and put it on the clipboard. Cutting data to the clipboard replaces the contents previously stored there. This command is unavailable if there is no object currently selected. The users can also invoke this command without accessing the drop-down menu by pressing Ctrl and X keys simultaneously on the keyboard.

Copy: Copies the selected object in either the view window or in the Players tab onto the clipboard. Copying data to the clipboard replaces the contents previously stored there. This command is unavailable if there is no object currently selected. The user can also invoke this command without accessing the drop-down menu by pressing Ctrl and C keys simultaneously on the keyboard.

Paste: Inserts a copy of the clipboard contents at the insertion point on the Players tab tree structure. This command is unavailable if the clipboard is empty. The users can also invoke this command without accessing the drop-down menu by pressing Ctrl and V keys simultaneously on the keyboard.

Delete: Permanently removes the currently selected object in either the view window or in the Players tab of the associated control bar window from the document. This command is unavailable if there is no object currently selected. The users can also invoke this command without accessing the drop-down menu by pressing Del key on the keyboard.

Find Player: Displays a dialog box as shown in Figure 3-4 allowing the users to locates a player on the tree structure displayed in Players tab that matches the search criteria as described below. This command also can be invoked without accessing the drop-down menu by pressing Ctrl and F keys simultaneously on the keyboard.

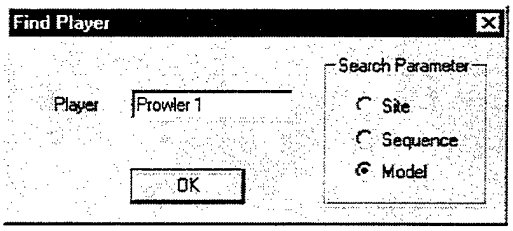

Figure 3-4. Find Player Dialog Box

- Site: Searches for matches among the names displayed on the tree in the Players tab of the Scenario Workbook described in Chapter XII.
- Sequence: Searches for a uniquely matching sequence number that defined on the player's Identification Property page described in Chapter XII.
- Model: Searches for players matching the model name specified.

Find Next: Repeats the previous Find Player search. This command also can be invoked without accessing the drop-down menu by pressing F3 key on the keyboard.

C. VIEW MENU COMMANDS

The View menu, as shown in Figure 3-5, contains the functions necessary to manipulate the view window display. The individual menu items are described below.

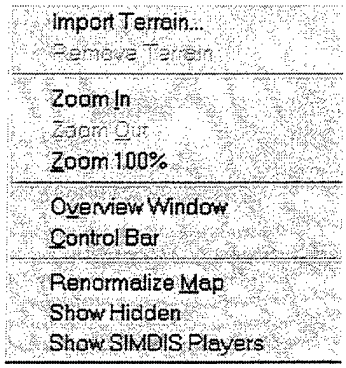

Figure 3-5. View Drop-Down Menu

Import Terrain: Calls a file selection box allowing the users to select a ".lan" terrain file for map display in ARES Edit view window. ARES uses terrain in all of its LOS calculations.

Remove Terrain: Deletes the terrain map display from ARES Edit view window.

Zoom In: Zooms into a point on a map view in ARES Edit view window. Once Zoom In is selected, successive clicks of the mouse will magnify by a factor of 2.

Zoom Out: Zooms out of a point on a map view in ARES Edit view window. Once Zoom Out is selected, successive clicks of the mouse will de-magnify by a factor of 2 until normal magnification is restored.

Zoom 100%: Restores map view in ARES Edit view window to normal magnification.

Overview Window: Opens an overview window, which provides a view of the entire scenario. The overview window also allows panning. This command is not accessible from the Execute and Chart view.

Control Bar: Allows the users to display or hide the control bar relevant to the current view. In the Edit view, this will display or hide the Scenario Workbook. In the Execute view, this will display or hide the Runtime Control bar. In the Chart view, this will display/hide the Post-proc Control bar.

Show Hidden: This command is a form of "declutter" button and allows the users to show all players which have been previously flagged to hide in ARES under the Players tab. This command is not accessible from the Execute and Chart view.

Show SIMDIS Players: Allows the users to hide/show those players that have been flagged to be hidden from SIMDIS under the Players tab [Ref. 3]. This command is not accessible from the Execute and Chart view.

D. TOOLS MENU COMMANDS

The Tools menu, as shown in Figure 3-6, contains the commands necessary to modify the appearance of an object and tool bar menu. The individual menu items are described below.

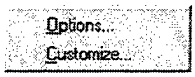

Figure 3-6. Tools Drop-Down Menu

Options: Displays the options dialog box, shown in Figure 3-7, which has four primary features described below.

- IFF: This box allows the users to specify whether a particular force in the scenario is friend, foe, or neutral. This affects only the color with which that force is displayed (Friend: blue, Foe: red, Neutral: grey). Double clicking a force letter will display the IFF dialog box as shown in Figure 3-8 from which the users can make their selection.

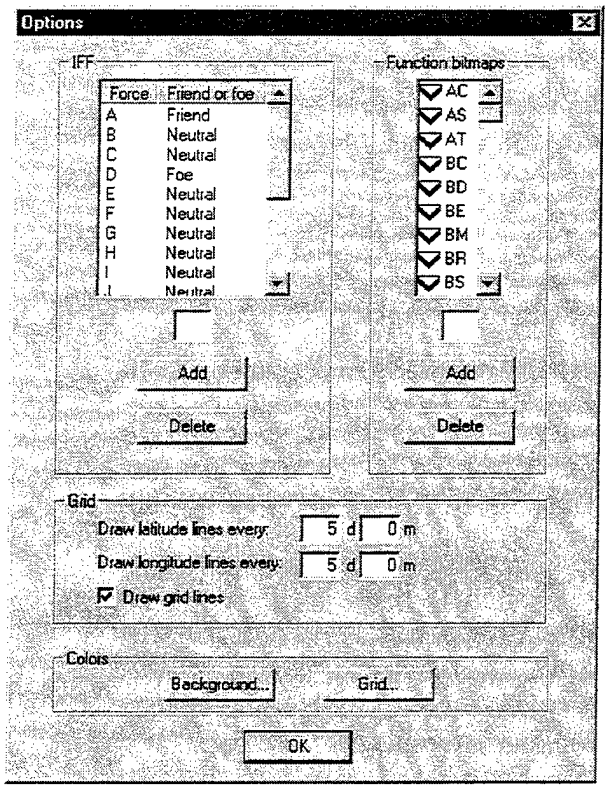

Figure 3-7. Options Dialog Box

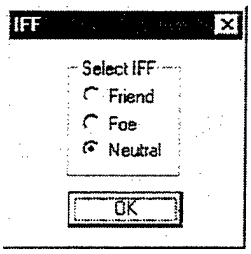

Figure 3-8. IFF Dialog Box

- Function Bitmaps: This box allows the users to change the default bitmap for a given function code. This affects only the bitmap with which an object of a given function code is displayed. Double clicking on a bitmap will display the Bitmap dialog box as shown in Figure 3-9 from which the users can make their selection.

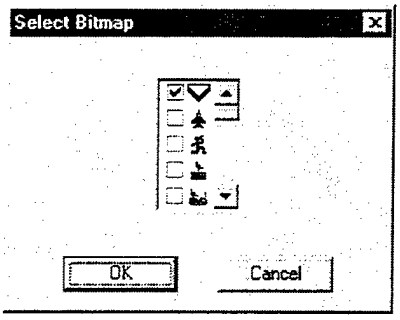

Figure 3-9. Bitmap Diaglog Box

- Grid: This box allows the users to change the default grid line spacing. Also, the users may choose to not display grid lines by de-selecting the check box.

- Colors: Pushing either the Background or Grid button displays a dialog as shown in Figure 3-10 to change the color of these two displayed items.

Customize: Displays the Customize dialog box, as shown in Figure 3-11, allows the users to change the appearance of tool bar menu.

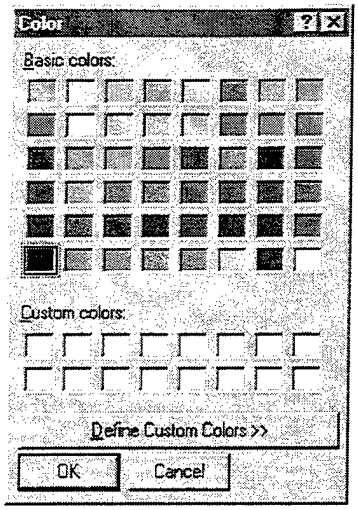

Figure 3-10. Color Selection Dialog Box

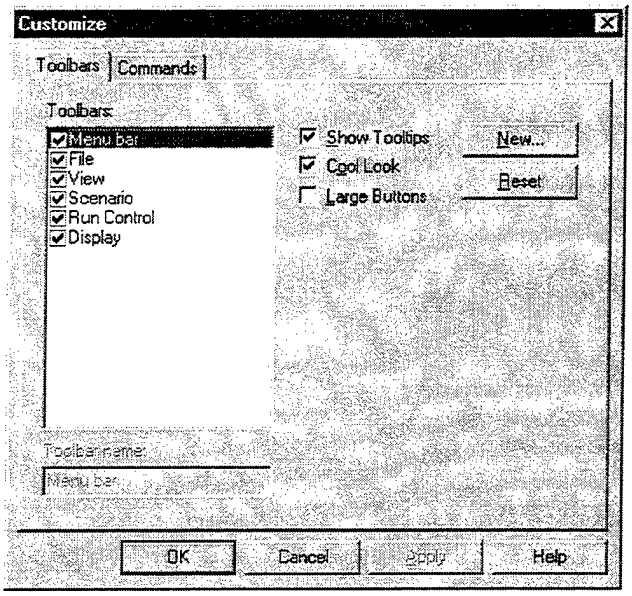

Figure 3-11. Toolbars Customize Dialog Box

E. SCENARIO MENU COMMANDS

The Scenario menu, as shown in Figure 3-12, contains the commands necessary to modify/create scenario in ARES. The individual menu items are described below.

Figure 3-12. Scenario Drop-Down Menu

Filter: Initiates a process to reduce the number of objects in a scenario that begins by displaying the filter dialog as shown in Figure 3-13. After selecting the properties of the objects the users wish to keep, pushing the "OK" button will result in the deletion of all objects that do not meet these criteria. Since the deleted objects can't be recovered, it is recommended that the scenario be saved prior to filtering. This command is not accessible from the Execute and Chart view.

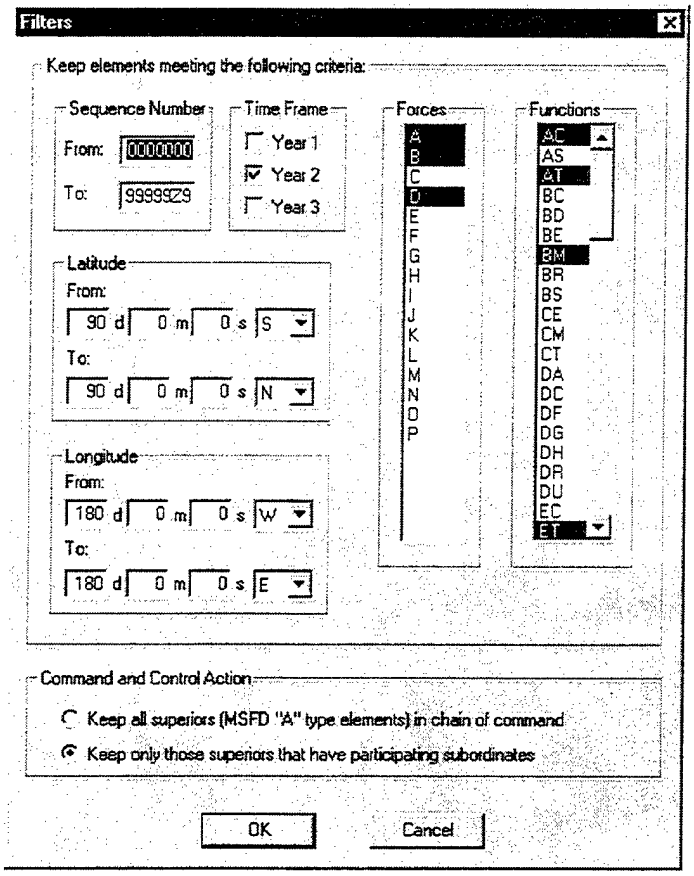

Figure 3-13. Filter Dialog Box

Add Player: Displays a pop-up menu as shown in Figure 3-14 for creating a new, neutral object of selected type at the geographic center of the scenario. Choosing any item from this menu presents a dialog box listing available models of the chosen type

for selection. These models must have been previously created on the Templates tab of the Scenario Workbook (see Chapter XI).

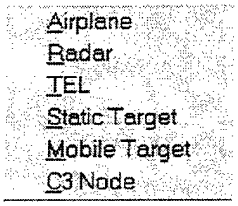

Figure 3-14. Add Player Pop-Up Menu

Convert: Displays the Player Type dialog as shown in Figure 3-15 allowing the users to convert the selected object from one type to another. This command is not accessible from the Execute and Chart view.

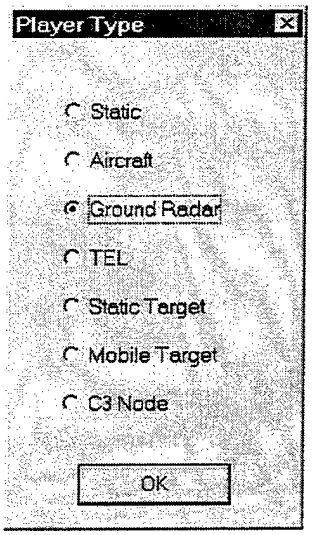

Figure 3-15. Player Type Selection Dialog Box

F. GRAPH MENU COMMANDS

The Graph menu, as shown in Figure 3-16, contains several commands necessary to format the appearance of a graph in ARES Chart view window (see Chapter XIV). The individual menu items are described below.

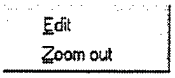

Figure 3-16. Graph Drop-Down Menu

Edit: Displays the Chart Explorer dialog, similar to Figure 3-17, with which the users can customize the appearance of the graph to produce a presentation quality product by changing the font, title, legend, chart type, and several other features.

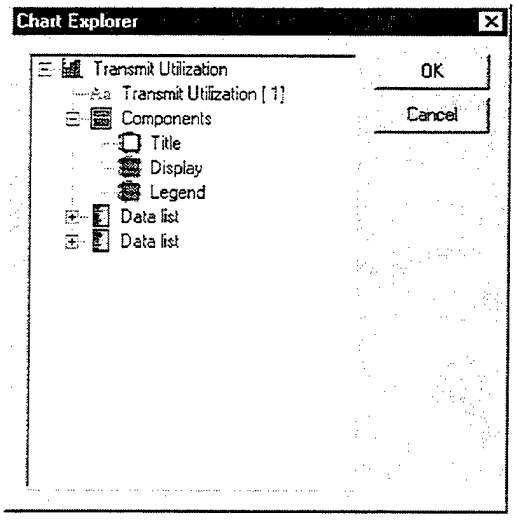

Figure 3-17. Chart Explorer Dialog Box

Zoom Out: Zooms out of a graph that has been zoomed in using the mouse. Selecting zoom out once will zoom out one level. Repeated zoom out's may be required to restore the full display.

G. WINDOW MENU COMMANDS

The Windows menu, as shown in Figure 3-18, contains several commands that help the users organize windows on the screen. The individual menu items are described below.

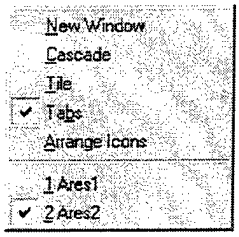

Figure 3-18. Window Drop-Down Menu

New Window: Creates a new window for the same document in ARES. This may be useful if the users wish to simultaneously open multiple views of the same document.

Cascade: Organizes several open documents in the form of a cascade.

Tile: Organizes several open windows as tiles.

Tabs: Organizes several open documents using tabs for quick easy way to switch among documents.

Arrange Icons: Arranges minimized window icons along the bottom of the view window frame. This is probably the least used and most unimportant command in all of ARES.

H. HELP MENU COMMANDS

The Help menu, as shown in Figure 3-19, allows the users to view the ARES copyright notices and online help. The individual menu items are describes below.

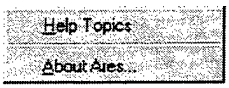

Figure 3-19. Help Drop-Down Menu

Help Topics: Opens the ARES help file and offers the users an index to topics on which the users can get help.

About ARES: Opens the dialog, as shown in Figure 3-20, which contains the current version number as well as contact information.

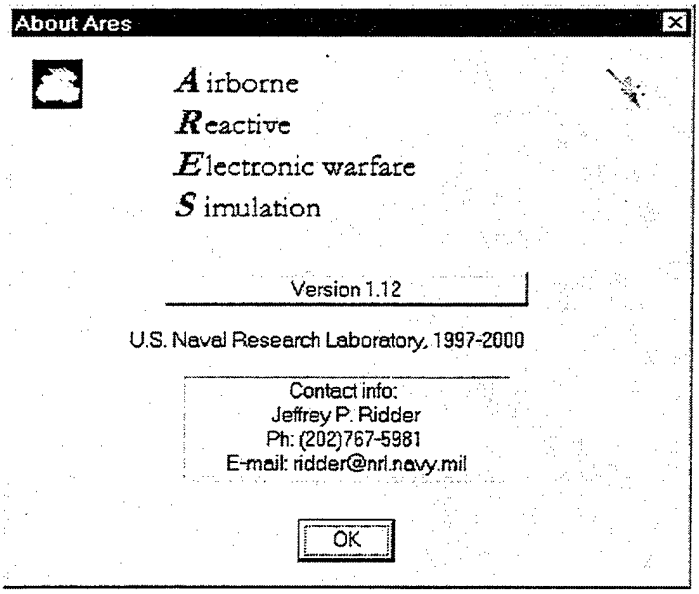

Figure 3-20. About ARES Dialog Box

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IV. TOOL BAR MENU

ARES tool bar, as shown in Figure 4-1, consists of thirty-four icon buttons organizing into five build-in toolbars. Features of each toolbar are summarized in the following sections. Note that if a command is unavailable in the current view, its button appears greyed out.

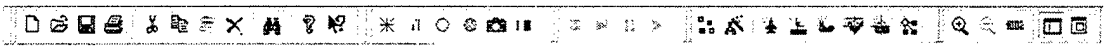

Figure 4-1. Tool Bar Menu

A. FILE BAR COMMANDS

The File built-in toolbar, shown in Figure 4-2, contains eleven icon buttons which are shortcuts to commonly used menu commands for file handling, editing object, and activate help. Function associated with individual button is summarized in Table 4-1.

Figure 4-2. File Build-In Toolbar

B. DISPLAY BAR COMMANDS

The Display build-in toolbar, shown in Figure 4-3, is comprised of six icons buttons associated with display controls. The individual button commands are described in Table 4-2.

Figure 4-3. Display Build-In Toolbar

TOOL BAR	COMMAND
	New: Creates a new document.
	Open: Opens an existing document.
	Save: Saves an opened document using the same file name.
	Print: Prints a document.
	Cut: Deletes the currently selected object in either the view window or in the Players tab from the document and moves it to the clipboard.
	Copy: Copies the selected object in either the view window or in the Players tab onto the clipboard.
	Paste: Pastes data from the clipboard contents at the insertion point on the Players tab tree structure.
	Delete: Permanently deletes the currently selected object in either the view window or in the Players tab from the document.
	Find Player: Displays a dialog box as shown in Figure 3-4 allowing the users to locates an object on the tree structure displayed in Players tab that matches a defined search criteria
	About ARES: Displays information about this application.
	Help Topics: Offers the users an index to topics on which the users can get help.

Table 4-1. File Toolbar Button Summary

C. RUN CONTROL BAR COMMANDS

The Run Control built-in toolbar, shown in Figure 4-4, consist of four buttons allowing the users to start or stop scenario execution. Individual button associated function is detailed in Table 4-3.

Figure 4-4. Run Control Build-In Toolbar

TOOL BAR	COMMAND
	Display Networks: Toggles On/Off the display of drawn lines representing networks connecting players on the map in Edit view window. The line color corresponds to the network as defined on the Templates Tab of the Scenario Workbook.
	Display Waypoints: Toggles On/Off the display of drawn lines connecting the waypoints of any mobile players in the scenario in Edit view window. The line color is assigned on the Waypoints Property page for the player.
	Display Radar Ranges: Toggles On/Off the display of circles representing reference detection range for each radar in Edit view window. The reference range is defined on the Radar Properties page available under the Systems Tab.
	Display Lethal Ranges: Toggles On/Off the display of crosshatched circles representing a reference lethal range for each weapon system in Edit view window. The reference range is defined on the Edit Weapon page available under the Templates Tab.
	Power Density Snapshot: Toggles On/Off the display of the computed jamming power density contours results on the Edit view windows.
	Display Color Bar: This option is not currently implemented.
	Display Parameters: Allows the users to set the reference RCS and altitude that are used by ARES to scale the displayed threat and detection range rings.

Table 4-2. Display Toolbar Button Summary

TOOL BAR	COMMAND
	Stops Execution: Terminates a run in progress. Once terminated, the run cannot be restarted. This shortcut command is not accessible from the Edit and Chart view.
	Stop After Iteration: Terminates a run in progress after the current iteration is complete. Once terminated, the run cannot be restarted. This shortcut command is not accessible from the Edit and Chart view.
	Pause: Pauses a run in progress. A paused run can be resumed by selecting the pause command a second time. This shortcut command is not accessible from the Edit and Chart view.
	Run: Executes a run. . This shortcut command is not accessible from the Edit and Chart view.

Table 4-3. Run Control Toolbar Button Summary

D. SCENARIO BAR COMMANDS

The Scenario built-in toolbar, shown in Figure 4-5, contains eight icon buttons, which are shortcuts to commonly used menu commands necessary for creating scenario. The individual button functions are explained in Table 4-4.

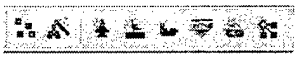

Figure 4-5. Scenario Build-In Toolbar

E. VIEW BAR COMMANDS

The View built-in toolbar, shown in Figure 4-6, consists of five buttons. These buttons are short cut to commonly used viewing control commands. Functions associated with the individual button are described in Table 4-5.

Figure 4-5. View Build-In Toolbar

TOOL BAR	COMMAND
	Filter: Initiates the filter dialog box as shown in Figure 3-13 in which the users can selectively reduce the number of objects in a scenario. After selecting the properties of the objects the users wish to keep, pushing the "OK" button will result in the deletion of all objects that don't meet these criteria. Since the deleted objects can't be recovered, it is recommended that the scenario be saved prior to filtering.
	Convert: Displays the Player Type dialog box as shown in Figure 3-15 allowing the users to convert an object from one type to another.
	Add Player Airplane: Create a new, neutral object of type "airplane" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available airplane models. These models must have been previously created on the Templates tab of the Scenario Workbook.
	Add Player Radar: Create a new, neutral object of type "radar" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available radar models. These models must have been previously created on the Templates tab of the Scenario Workbook.
	Add Player TEL: Create a new, neutral object of type "TEL" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available radar models. These models must have been previously created on the Templates tab of the Scenario Workbook.
	Add Static Target: Create a new, neutral object of type "static" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available static target models. These models must have been previously created on the Templates tab of the Scenario Workbook.
	Add Mobile Target: Create a new, neutral object of type "mobile" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available mobile target models. These models must have been previously created on the Templates tab of the Scenario Workbook.
	Add Player C3 Node: Create a new, neutral object of type "C3 Node" at the geographic center of the scenario. Clicking the button invokes a dialog box presenting a list of available C3 node models. These models must have been previously created on the Templates tab of the Scenario Workbook.

Table 4-4. Scenario Toolbar Button Summary

TOOL BAR	COMMAND
	Zoom In: Zooms into a point on a map view. Once Zoom In is selected, successive clicks of the mouse will magnify by a factor of 2.
	Zoom Out: Zooms out of a point on a map view. Once Zoom Out is selected, successive clicks of the mouse will de-magnify by a factor of 2 until normal magnification is restored.
	Zoom 100%: Resets magnification to normal.
	Control Bar: Shows/hides the control bar relevant to the current view. In the Edit view, this will display the Scenario Workbook. In the Execute view, this will display the Runtime Control bar. In the Playback view, this will display the Playback Control bar.
	Overview Window: Shows/hides the overview window which provides a view of the entire scenario. The overview window also allows panning.

Table 4-4. View Toolbar Button Summary

V. EDIT VIEW WINDOW

The Edit view window is the first of the three views available for an ARES document, and is probably the view the users spend most of the time in. It is activated by selecting the "Edit" tab along the bottom of the current document's view window frame. By default, it is automatically started when a new or existing file is opened in ARES. In this view, a map view is displayed with the geographical location of all of the objects in the scenario. Whenever the Edit view is active, the Scenario Workbook, which consists of four tabs, is displayed in the Control Bar window, along with the status bar extending across the bottom of the ARES window.

There are many features to be aware of in the Edit view. The first of these are the display functions available to the users via the Display Toolbar. The buttons on this toolbar may be used to display networks, waypoints, radar range rings, and lethal ranges.

Another feature available from the Edit view is the Overview window. The overview presents a miniature window with a view of the entire scenario, and can be used to pan the larger edit view. The Edit view also supports a zoom capability via the View bar. The current zoom level is displayed on the status bar.

The objects displayed in the Edit view window is selected by clicking on them once with the left mouse button. When selected, the object and all of its subordinates are highlighted in yellow. Since the Edit view and the Scenario Workbook are synchronized, the selected object is also highlighted and displayed on the Players tab of the Scenario Workbook.

Double-clicking an object from the Edit view opens it for editing. The result of this action is the same as double-clicking the object from the Players tab of the Scenario Workbook. The Edit view also supports standard cut, copy, paste, and delete functions. These commands may be accessed by right-clicking on an object in the view window in addition to the Edit drop-down menu and File toolbar menu. Note that cut, copy and delete operate on all selected (highlighted in yellow) objects.

A. STATUS BAR DISPLAY

As mentioned in Chapter II, the status bar displayed from the Edit view presents five panes of information, which differs depending on whether an object is currently selected or not in either the view window or in the Players tab of the Scenario Workbook.

1. No Object Selected

If there is no object selected, then the status bar appears as in Figure 5-1. The first three panes display the latitude, longitude, and height above the ground in feet of the mouse cursor and update continuously as the mouse is moved over the map view. When there is no terrain displayed, the third pane shows "0 ft" for height level. The fourth pane displays the current zoom level. The fifth pane displays the number of objects currently selected. Obviously, when no objects are selected this pane shows "0".

Figure 5-1. Status Bar Display With No Object Selected

2. Object Selected

When an object is selected the status bar appears as in Figure 5-2. The first two panes display the distance and bearing of the mouse cursor from the selected object. The

fourth pane displays the current zoom level. The fifth pane displays the number of objects currently selected.

Figure 5-2. Status Bar Display With A Selected Object

B. SCENARIO WORKBOOK CONTROL BAR WINDOW

The Scenario Workbook, as shown in Figure 5-3, is where most scenario creation and editing activities takes place. It is displayed when the "Edit" view is active. It contains four tabs and in general, scenarios are created by working from right to left. That is, radar cross-sections (RCS's) and antenna patterns are created first in the Signatures tab. Second, systems are created in the Systems tab. These systems can use an antenna pattern that was created in the Signatures tab. Third, templates are created in the Templates tab. The Templates tab includes the models and the networks. For example, a model might represent an F/A-18. The F/A-18 model may use the F/A-18 signature created on the Signatures tab, and the APG-65, ALR-67(v)2, and ALQ-126B created on the Systems tab. Finally, the active players are created in the Players tab based on the models and networks created on the Templates tab. If an MSFD file was imported, then the static players may be converted to active players as the appropriate templates are created. Descriptions of the Signatures, Systems, Templates, and Players tabs are detailed in Chapter VI through XII respectively.

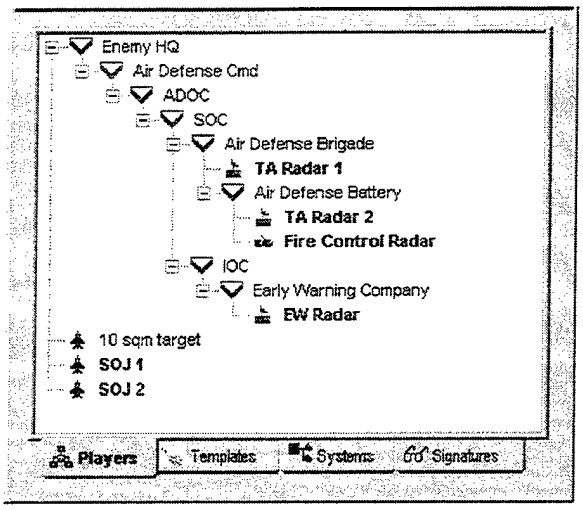

Figure 5-3. Scenario Workbook Control Bar Window

VI. SIGNATURES TAB COMMANDS

The "Signatures" tab of the Scenario Workbook displays all radar-cross-sections (RCS's) and antenna patterns available to objects in the scenario. The signatures are listed in alphabetical order, as similarly shown in Figure 6-1.

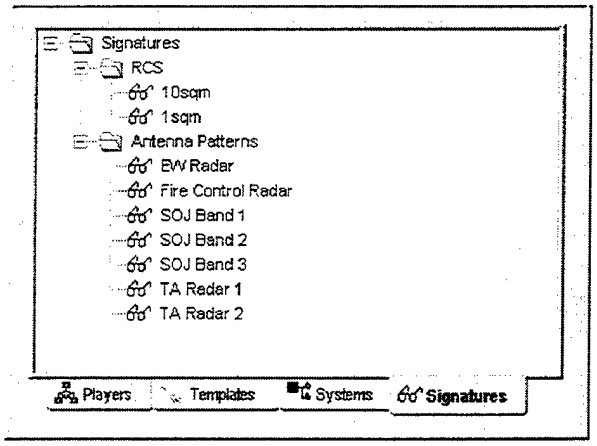

Figure 6-1. Sample of Signatures Tab Hierarchy

A. TREE OPERATIONS

The tree presented in the Signatures tab supports two basic operations. These are described as follows:

1. Right-Clicking a Folder

Right-clicking either the "RCS" or "Antenna Patterns" folder presents the users with a context-sensitive menu as shown in Figure 6-2. The two operations of interest are **Add** and **Import**.

Add: Creates of a new signature object. The new object is initially blank and must be edited prior to use.

Import: Prompts the users to select a text file to open. The data in the text file will then be imported into a newly created signature. The signature text files may be

created by **Export** from another scenario. Or, if the users understand the format of the text file, the users can create signature files in other programs that can be imported into ARES.

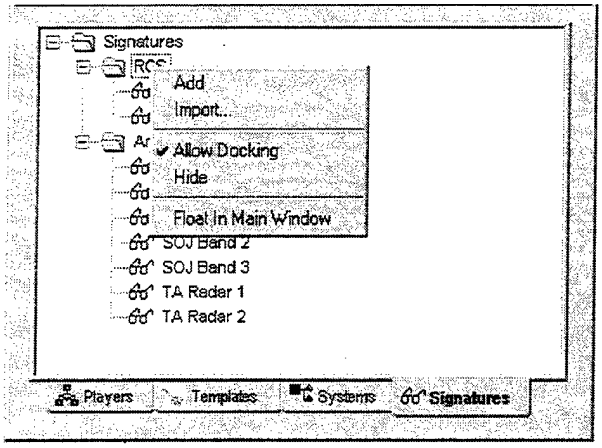

Figure 6-2. Folder Pop-Up Menu in Signatures Tab

2. Right-Clicking a Signature

Right-clicking on an object in either folder presents the users with a context-sensitive menu as shown in Figure 6-3. There are three operations of interest. These are **Open**, **Export**, and **Delete**.

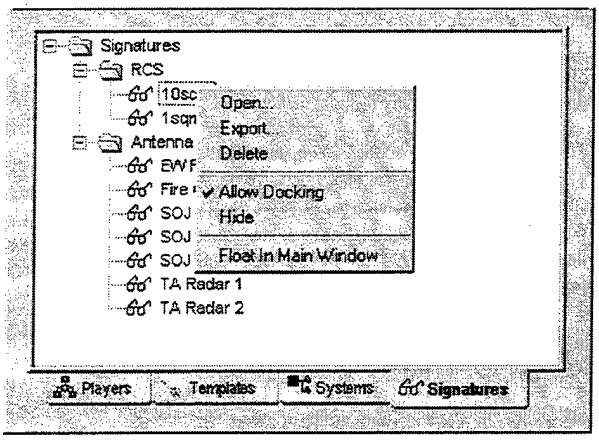

Figure 6-3. Signature Pop-Up Menu

Open: Opens the signature for editing. See Section B for further details in editing a signature.

Export: Prompts the users for the name of a text file to write the signature data into. This file may later be imported into another scenario, or it may be read into other programs for editing (e.g., Microsoft Excel).

Delete: Permanently removes the selected signature being from the scenario.

B. EDITING A SIGNATURE

Either double-clicking the object in the Signatures tab or by right-clicking and selecting **Open** from the pop-up menu opens a dialog page for editing. The dialog page for both the RCS's and the antenna patterns is identical with the exception of the dialog heading. A sample RCS dialog page is provided in Figure 6-4. As shown, the dialog page contains six fundamental blocks of information. These are described in detail below.

Units: As described below, a unit of the values entered into the grid is different for the RCS's and the antenna patterns.

- RCS: The units of the values in the RCS table are square meters.
- Antenna Pattern: The units of the values in the Antenna Pattern table are decibels relative to the mainbeam gain. For antenna patterns, azimuth and elevation angles of (0, 0) correspond to the mainbeam. In many cases, this will be 0, although it may deviate from this if the users have multiple frequency tables and the mainbeam gain varies with frequency. Typically, the sidelobe values will be negative.

Name: A text string that is used to identify this signature table throughout ARES. It will be displayed on the Signatures tab, and is used in other lists as well. The users will want to use a concise, but descriptive name for the signatures.

Classification: The users can select the classification level of the signature from the drop-down list. The classification is used only for reference in the dialog.

Standard Deviation: A non-zero Sigma field will apply Gaussian noise to the sidelobe level with a standard deviation equal to the defined value. This will be applied only to azimuth and elevation angles as specified in the Applies to Az Greater Than and Applies to El Greater Than fields.

Angles: The elevation angles are entered in degrees and cover the range from -90 to +90. The azimuth angles are also entered in degrees and cover the range from 0 to 360. The users can define the elevation and azimuth angles to be whatever the users want. ARES will linearly interpolate between the values entered regardless of angular resolution.

If an azimuth or elevation angle falls outside the range of the table, ARES will not linearly extrapolate outside the range. Rather, it simply uses the last value entered on the table to represent all values outside the range. For example, if the users enter data for azimuth angles from 30 to 330 degrees and an ARES calculation requires data from an angle of 350 degrees (at a given elevation), ARES will use the value at 330 degrees.

Add Frequency: This button adds a new table to the signature. The value of the frequency that this table represents can be edited by double-clicking on the tab for the new table. The frequency values are represented in MHz. Similar to the Angles above, ARES will interpolate between the tables based on the frequency, but will not extrapolate. It will use the values from the table closest in frequency to represent values outside the frequency range. For example, in the figure above, the table for 10,000 MHz

is used to represent all values above 10,000 MHz. Also, if only one table is available, then ARES uses that table to represent all values regardless of frequency. In this case, it is not necessary to edit the frequency value on tab.

Remove Current: This button permanently deletes the currently active table from the signature.

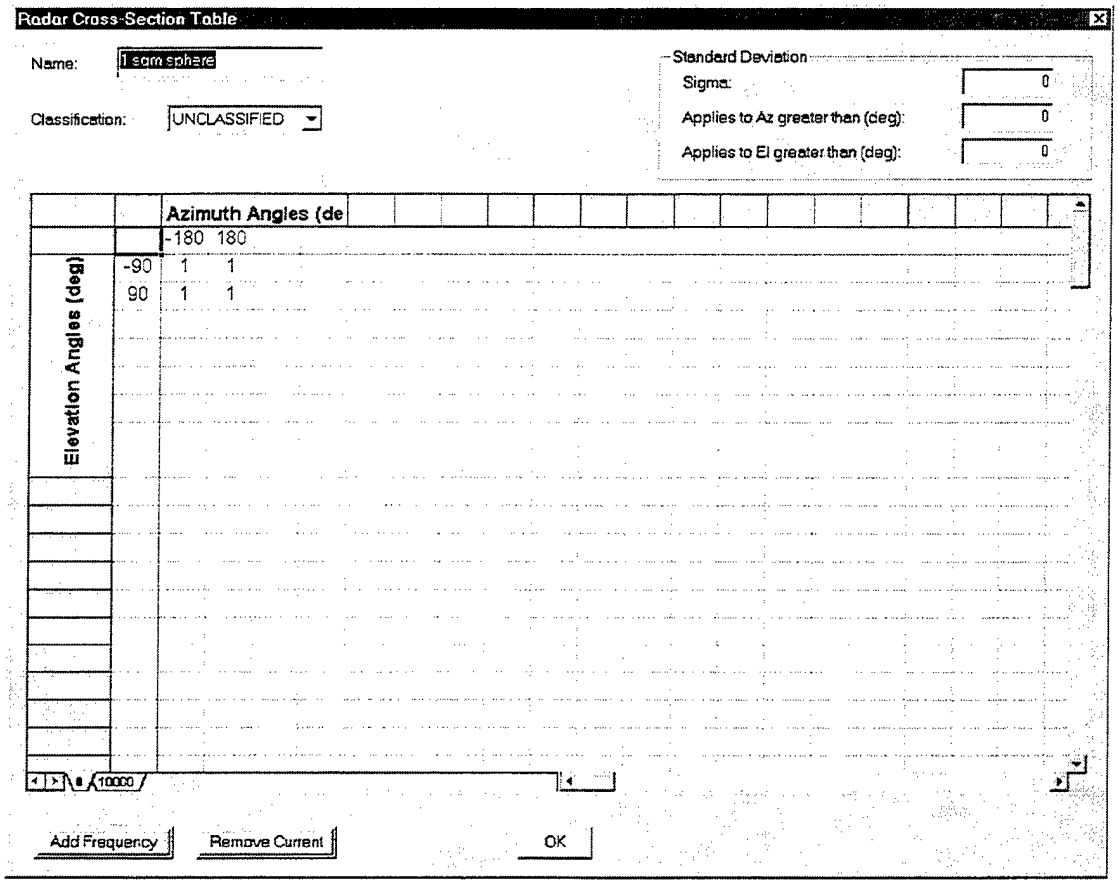

Figure 6-4. RCS Dialog Page

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VII. SYSTEMS TAB COMMANDS

The "Systems" tab of the Scenario Workbook displays radar, electronic support measure (ESM), and electronic countermeasure (ECM) systems available to radar and airplane models in the scenario. The systems are listed in alphabetical order by type. A sample of Systems Tab hierarchy is shown in Figure 7-1.

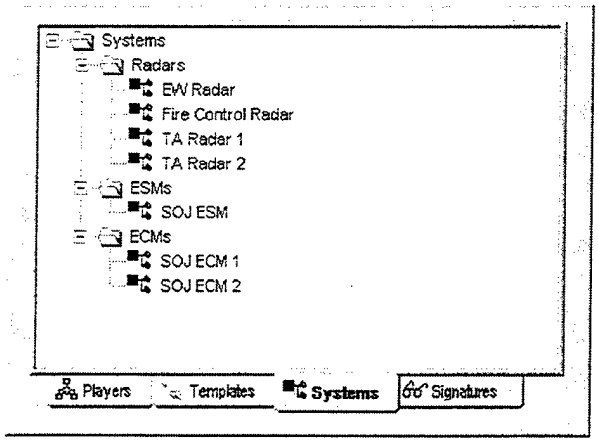

Figure 7-1. Sample of Systems Tab Hierarchy

A. TREE OPERATIONS

The tree presented in the Systems tab supports two basic operations. These are described as follows:

1. Right-Clicking a Folder

Right-clicking the **Radars**, **ESMs**, or **ECMs** folder presents the users with a context-sensitive menu as shown in Figure 7-2. The two operations of interest are **Add** and **Import**.

Add: Creates a new system object. The new object initially has no components (e.g., antennas, transmitters, etc.) and must be edited prior to use.

Import: Prompts the users to select a system file (*.rdr, *.esm, or *.ecm) to open. The data in the system file will then be imported and result in the creation of a new system object. The system files may be created by **Export** (see below) from this or another scenario. System files cannot be created outside of ARES.

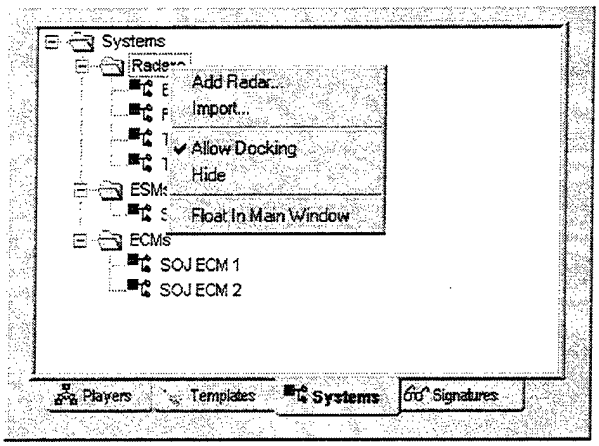

Figure 7-2. Folder Pop-Up Menu in Systems Tab

2. Right-Clicking a System

Right-clicking on an object in any folder presents the users with a context-sensitive menu as shown in Figure 7-3. There are four operations of interest. These are **Open**, **Export**, **Delete**, and **Duplicate**.

Open: Opens the system for editing. Detailed descriptions on editing a radar, an ESM, and an ECM are provided in Chapter VIII, IX, and X respectively.

Export: Prompts the users for the name of a system file to write the system object into. This file may later be imported into another scenario. These files are compatible only with ARES.

Delete: Permanently removes the selected system from the scenario.

Duplicate: Replicates the selected system onto the tree structure. The new system appears in the tree with the old name plus " (copy)".

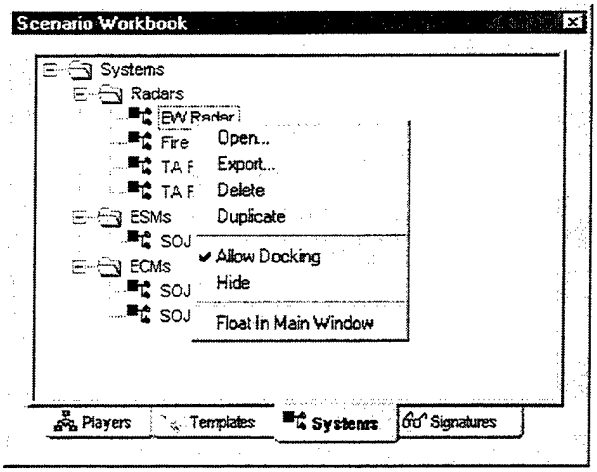

Figure 7-3. System Pop-Up Menu

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VIII. EDITING A RADAR

A radar system in the Systems tab is opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 8-1 which features seven pages: **Properties**, **Resources**, **Antennas**, **Transmitters**, **Receivers**, **Modes**, and **Report**. To build a radar system, the users have to create all of its components and then describe their operation using the **Modes** page. If this system is to participate on a network, the users can identify the information it can provide to a network on the **Report** page.

A. PROPERTIES

The Radar Properties page, as shown in Figure 8-1, contains six fundamental blocks of information. These are described in detail below.

Name: A text string that is used to identify the radar throughout ARES. It is displayed under the Radar folder on the Systems tab, and is used in other lists as well. It is imperative that the users define a concise, but descriptive name for the radar.

Classification: Is used only for reference in the dialog and is selected from the drop-down list.

Reference

- ELNOT. This is the Electronic Intelligence (ELINT) Notation identifier for this radar. This field is not used for anything in ARES. It is provided only for reference.
- Detection Range: This field is used for displaying a reference radar range on the Edit view window. This information can be found in the "System Information" section of the EWIRDB (Tree Number 000000000153).

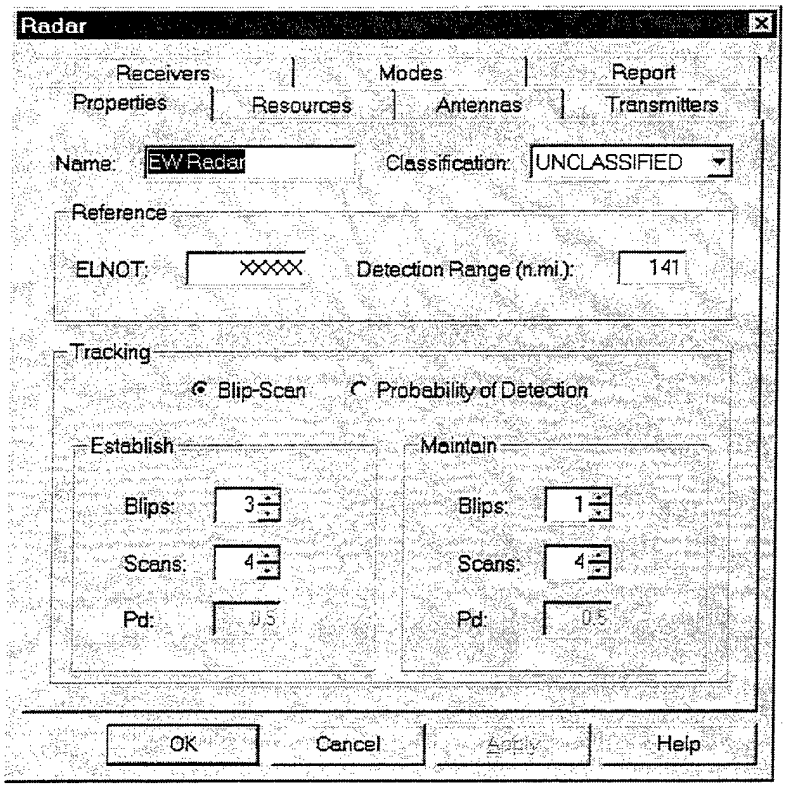

Figure 8-1. Sample of Radar Properties Dialog Page

Tracking: This block is where the users define whether radar tracking is based on Probability of Detection (Pd) or the Blip-Scan ratio. It is up to the users to determine which criteria is more appropriate. However, Blip-Scan ratio is generally more appropriate for reflecting "real-world", while Pd is more appropriate for calibrating the radars. The range at which detection occurs is much more uncertain for the blip-scan model than for the Pd model.

Track Establishment: This block is where the users indicate the criteria that ARES uses for the radar to establish an active track of a target. Based on the selection in the Tracking block, this is expressed in terms of the blip-scan ratio, the number of blips out of a requisite number of scans, or the probability at which detection occurs.

Typically, a value of 3 out 4 is used for blip-scan ratio and 0.5 in case of probability of detection.

Track Maintenance: This block is where the users specify the blip-scan ratio or the probability of detection required to maintain the active status of an already established track, based on the selection in the Tracking block. If the defined threshold is not achieved, then the track is dropped. Typically, a value of 1 out 4 is used for blip-scan ratio. In case of probability of detection, a value of 0.5 is used.

B. RESOURCES

This page, shown in Figure 8-2, is an optional advanced feature in ARES and is designed for special application in GA. Unless the users are knowledgeable about the defined system, this page can be ignored. In general, this page allows the users to specify the size, weight, and support requirements for the radar, which in turn is used for consideration in GA system selection process. If the GA develops a solution where the systems require more resources (the sum of their required resources) than the allowed maximum values for the platform as defined in the GA constraints page from the Templates page, then the GA will simply "turn off" that platform (i.e., not use it).

C. ANTENNAS

The Radar Antennas page contains a list of all antennas associated with this radar. A sample of the Radar Antennas page is shown in Figure 8-3. Below this list are four buttons described as follows:

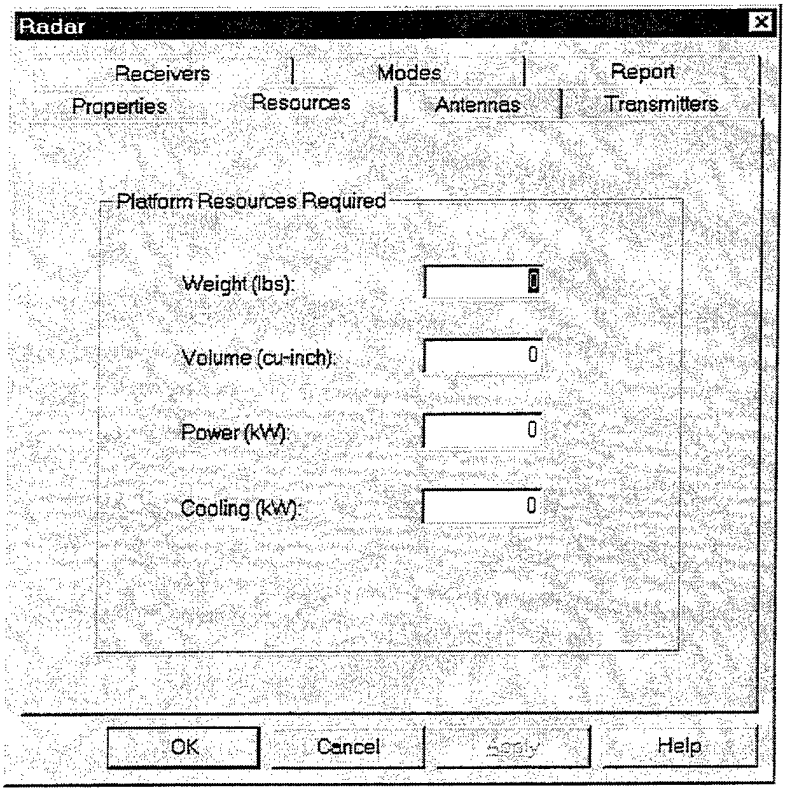

Figure 8-2. Sample of Radar Resources Dialog Page

Add: Adds new, but blank antennas object to the radar. It will be shown in the list as "New Antenna" and will immediately be opened for editing.

Edit: Opens the currently selected antenna for editing. Alternatively, double-clicking the antenna in the list will also open the antenna.

Delete: Permanently deletes the currently selected antenna from the radar object.

Duplicate: Creates a copy of the currently selected antenna. It will be listed with the same name as the copied antenna plus " (copy)".

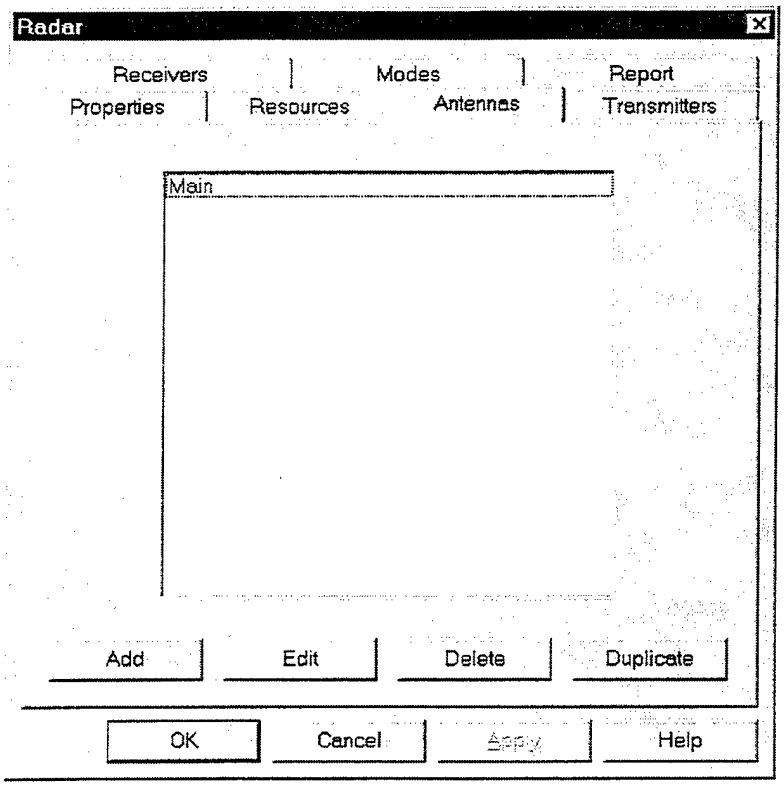

Figure 8-3. Sample of Radar Antenna Dialog Page

1. Editing an Antenna

With an antenna selected on the Radar Antennas page, double-clicking or selecting **Edit** presents the users with a radar antenna dialog containing two tabs as depicted in Figure 8-4. Description of each tab is as follows.

a. Properties

This page, as shown in Figure 8-4, contains several antenna properties to be edited as described below. Note that operating modes are edited in another dialog.

Name: A text string identifying this antenna in lists.

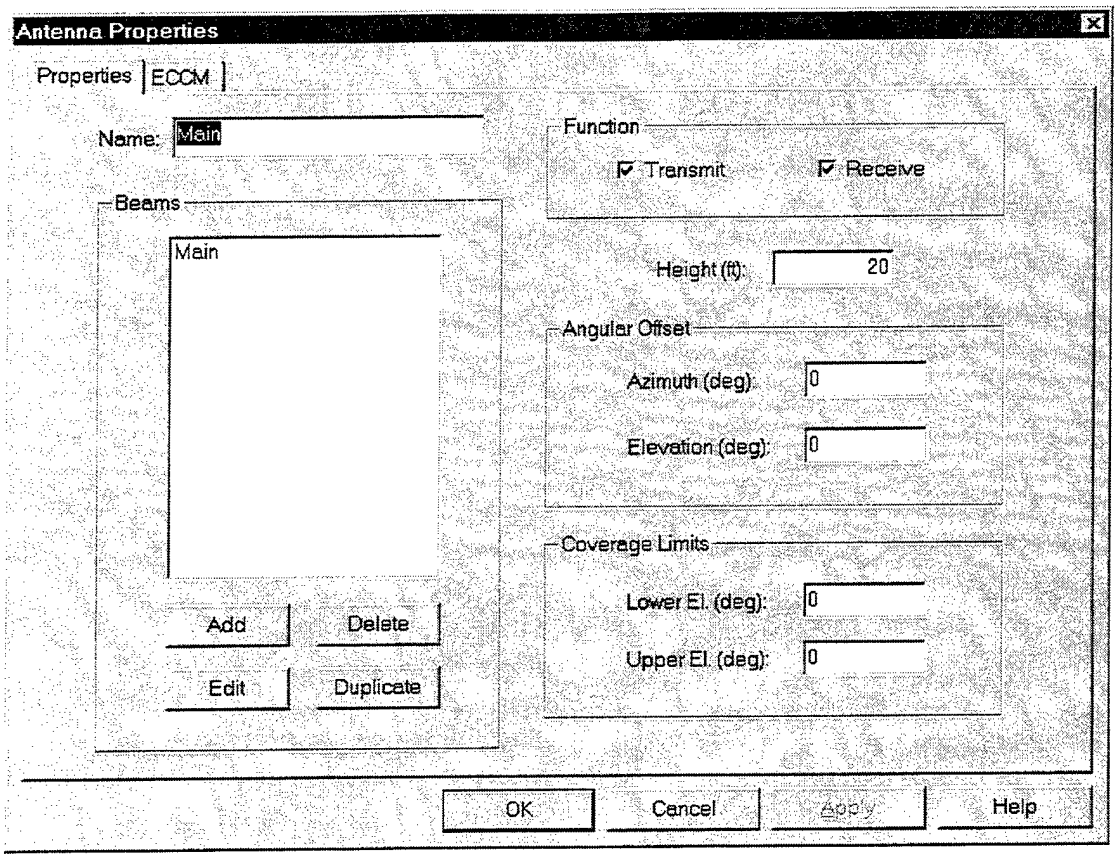

Figure 8-4. Sample of Antenna Properties Dialog Page

Function: Check the transmit and/or receive boxes as appropriate. To reduce execution time, for example, the users may wish to represent some radars as being transmitters only (i.e., they transmit signals to the environment, but the users may not care whether they make detections). In this case, the users would select the transmit box, but not the receive box.

Height: This is the height of the antenna above ground level (AGL) and is used in calculations to determine line-of-sight (LOS). This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223).

Angular Offset: The angular offset is used for describing the mounting of this antenna relative to the local "front". For example, a side-looking radar mounted on the right side of an aircraft would have an azimuth offset of 90 degrees. A rear facing radar would have an azimuth offset of 180 degrees. The angular offset does not describe scan or aiming sector. It is simply an offset relative to the platform on which the antenna is mounted.

Coverage Limits: Defines the antenna elevation scan coverage angle in degrees. The specified values are used in determine just how far the antenna can be steered in order to keep track of its targets when dynamic steering of the antenna is selected on the Antenna Modes page. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223).

Beams: This block lists the beams associated with this antenna and provides four "action" buttons.

- Add: This button adds a "New Beam" to the list and opens it for editing.
- Edit: This button opens a beam for editing. Double-clicking the beam in the list has the same effect.
- Delete: This button permanently removes the currently selected beam from the antenna.
- Duplicate: This button creates a copy of the currently selected beam. It will appear in the list with the name of the copied beam plus " (copy)".

With a beam selected on the Beams list, double-clicking or selecting **Edit** presents the users with the Beam Properties dialog containing several properties to be edited as defined below. Note that operating modes are edited in another dialog. A sample of Beam Properties dialog is provided in Figure 8-5.

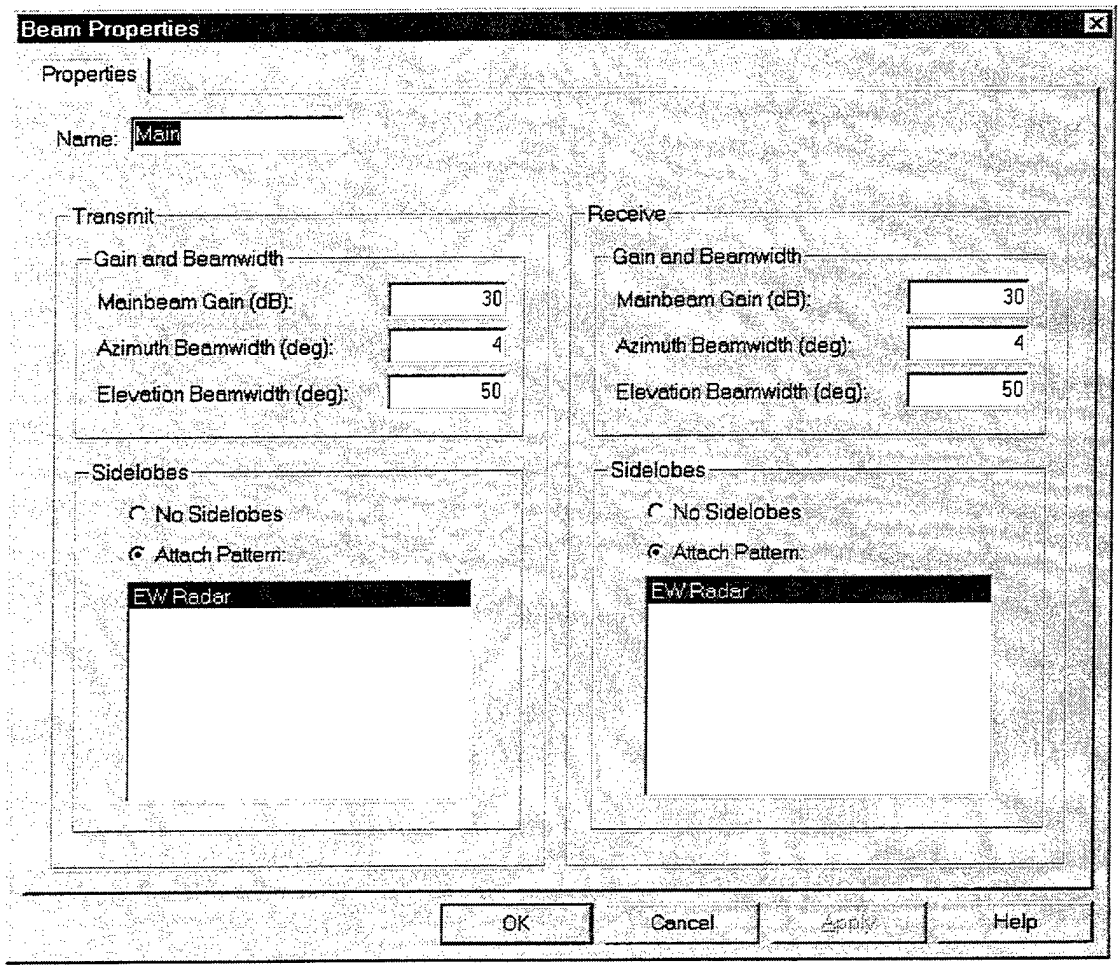

Figure 8-5. Sample of Antennas Beam Properties Dialog Page

Name: This is a text string identifying this beam in lists.

Transmit / Receive: ARES allows the users to specify beam properties for both transmit and receive. It selects the appropriate properties based on context. For example, an ESM looking at a radar uses the transmit properties of the beam, while a radar receiver uses the receive properties. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223).

- Mainbeam Gain: This is the gain (in dB) associated with this beam. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223). If it is not given, this value can be

calculated using equation below where θ_a and θ_e are the 3-dB azimuth and elevation beamwidths in radians.

$$G \cong \frac{4\pi}{\theta_a \theta_e} \qquad (8.1)$$

- Azimuth / Elevation Beamwidth: This is the 3-dB azimuth and elevation beamwidths in degrees of this beam. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223).

Sidelobes: For both transmit and receive, the users have the option of identifying a particular antenna pattern to associate with this beam, or the users can choose to have no pattern. The patterns available to the users are those that were created under the Signatures tab. For this reason, the users should create the signatures before create the systems. If the users choose no sidelobes, ARES uses 0 dBi (isotropic) to represent all values outside of the mainbeam.

b. ECCM

This page, shown in Figure 8-6, is an optional advanced feature in ARES and is designed for special application in coherent sidelobe cancellers. Unless the users are knowledgeable about the subject, this page can be ignored. In general, this page allows the users to define each row to represent one auxiliary antenna (one cancellation loop) with the following parameters:

Aux Az / El FOV: This field specifies the azimuth and elevation field of view (FOV) for each auxiliary antenna.

Az / El Offset: This field specifies the azimuth and elevation boresight angles of the auxiliary antenna relative to the antenna boresight.

Cancellation: This field specifies the amount of the cancellation ratio by which the jamming noise of any high duty cycle jammer that is within FOV of the auxiliary antenna is reduced. The cancellation algorithm takes into account the number of jammers and the number of auxiliary antennas that have the jammers within their field of view to compute the amount of cancellation applied against each jammer.

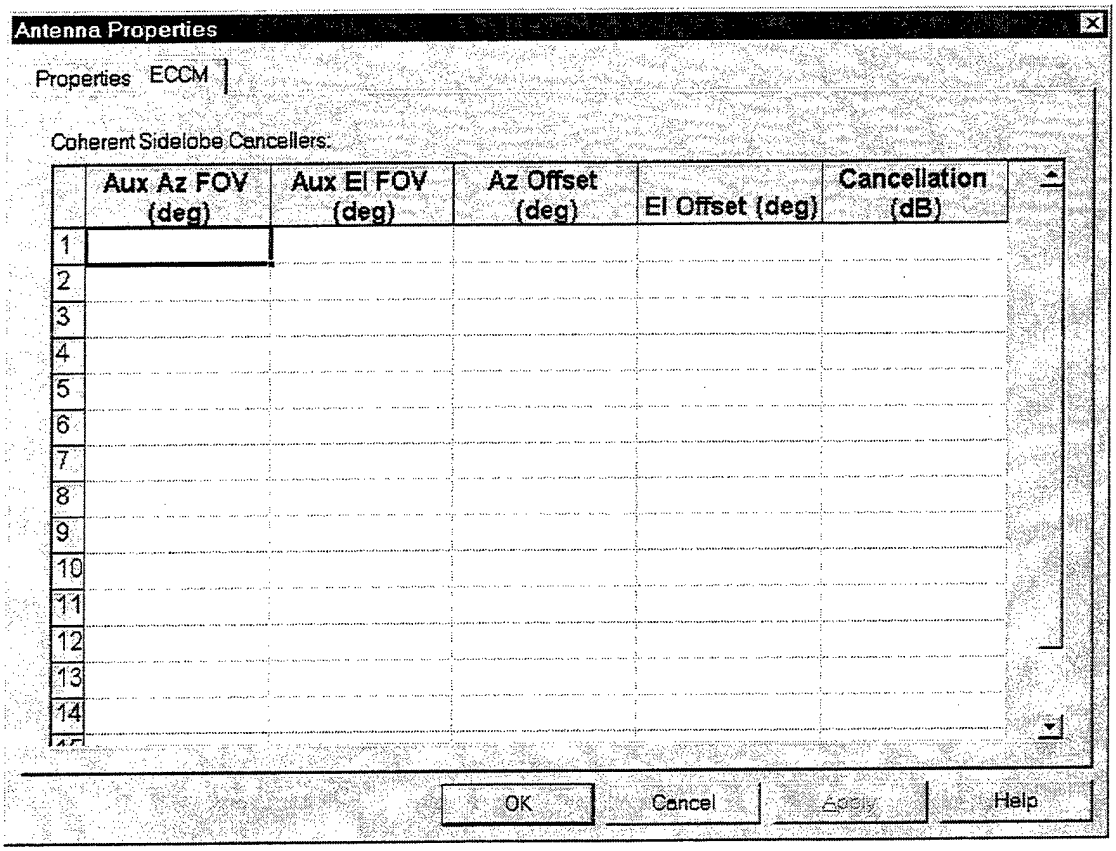

Figure 8-6. Sample of Antennas ECCM Dialog Page

D. TRANSMITTERS

The Radar Transmitters page contains a list of all transmitters associated with this radar, as similarly shown in Figure 8-7. Below this list are four buttons described below.

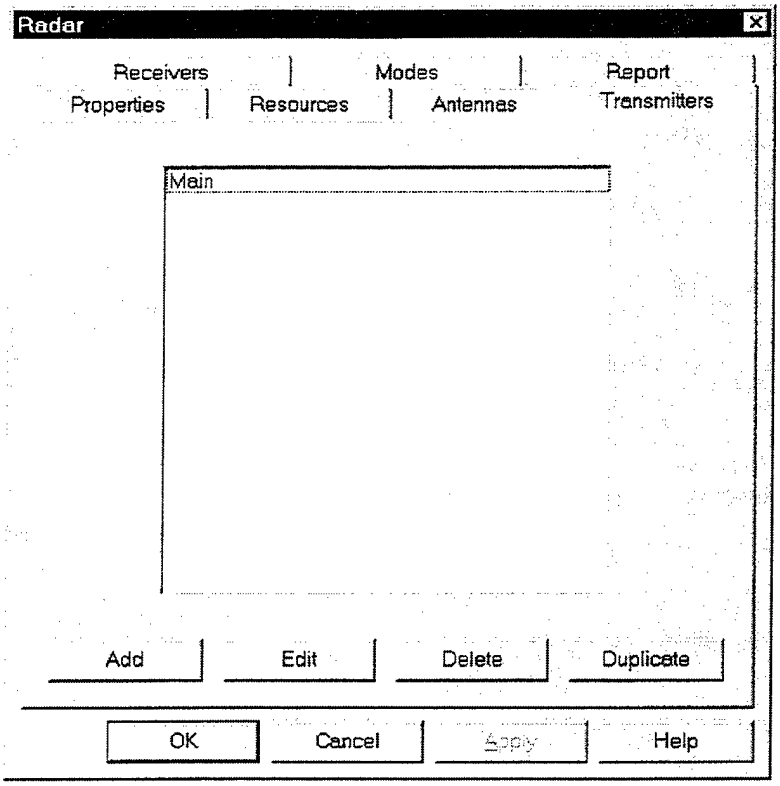

Figure 8-7. Sample of Radar Transmitters Dialog Page

Add: Adds a new, but blank transmitter object to the radar. It will be shown in the list as "New Transmitter" and will immediately be opened for editing.

Edit: Opens the currently selected transmitter for editing. Alternatively, double-clicking the transmitter in the list will also open the transmitter.

Delete: Permanently deletes the currently selected transmitter from the radar object.

Duplicate: Creates a copy of the currently selected transmitter. It will be listed with the same name as the copied transmitter plus " (copy)".

1. Editing a Transmitter

With a transmitter selected on the list, double-clicking or selecting **Edit** presents the users with the Transmitter Properties dialog contains several properties to be edited. Note that operating modes are edited in another dialog. A sample of the Transmitter Properties dialog is provided in Figure 8-8.

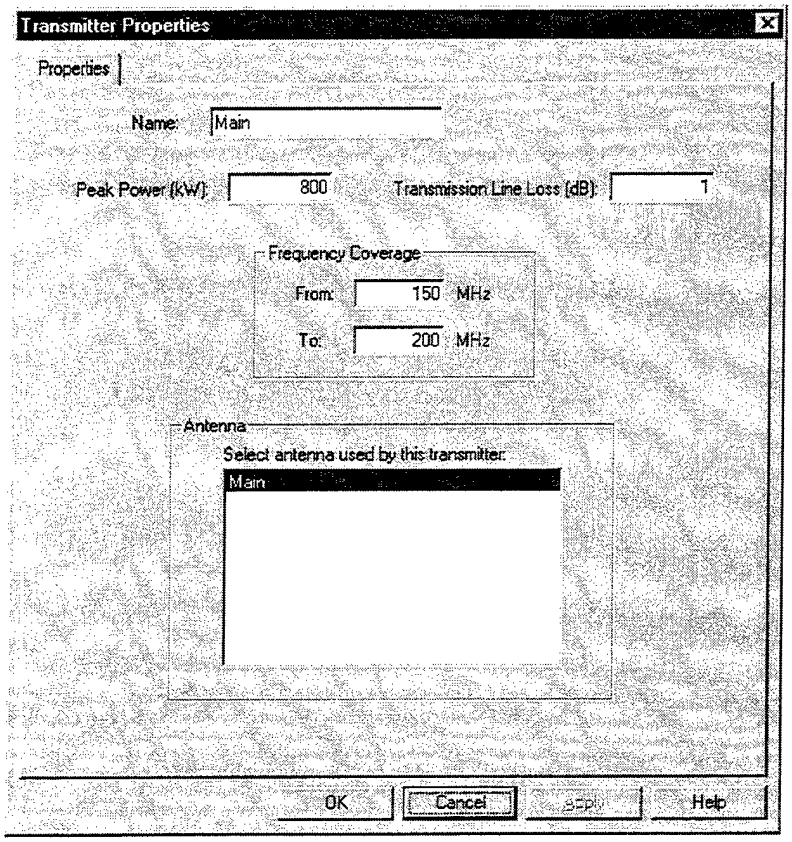

Figure 8-8. Sample of Radar Transmitter Properties Dialog Page

Name: A text string identifying the transmitter in lists.

Peak Power: Defines the peak pulse power in kilowatt to be used for this transmitter. A single-pulse signal-to-noise (S/N) is computed using this value. Combined with number of integrated pulses (pre- or post-detection) as determined by the illumination time based on the scan, the resulted calculation is used to determine the

probability-of-detection. ARES uses a Marcum-Swerling model to determine probability-of-detection. This information can be found in the "Signal Power" section of the EWIRDB (Tree Number 000000000011).

Transmission Line Loss: The effective radiated power (ERP) of the radar is determined using the peak power, antenna gain, and this value of transmission line loss (in dB). This information can be found in the "Signal Power" section of the EWIRDB (Tree Number 000000000011).

Frequency Coverage: Defines the operating frequency range of this transmitter (in MHz). A radar could have several transmitters, each covering a different frequency range. This information can be found in the "Pulsed RF" section of the EWIRDB (Tree Number 000000013132).

Antenna: Single-click to select an antenna to be used by this transmitter. The antennas listed are those that were created on the Antennas page and that have the Transmit property selected. Double-clicking has no effect in this list.

E. RECEIVERS

The Radar Receivers page, as shown in Figure 8-9, contains a list of all receivers associated with this radar. Below this list are four buttons described below.

Add: Adds a new, but blank receiver object to the radar. It will be shown in the list as "New Receiver" and will immediately be opened for editing.

Edit: Opens the currently selected receiver for editing. Alternatively, double-clicking the receiver in the list will also open the receiver.

Delete: Permanently deletes the currently selected receiver from the radar object.

Duplicate: Creates a copy of the currently selected receiver. It will be listed with the same name as the copied receiver plus " (copy)".

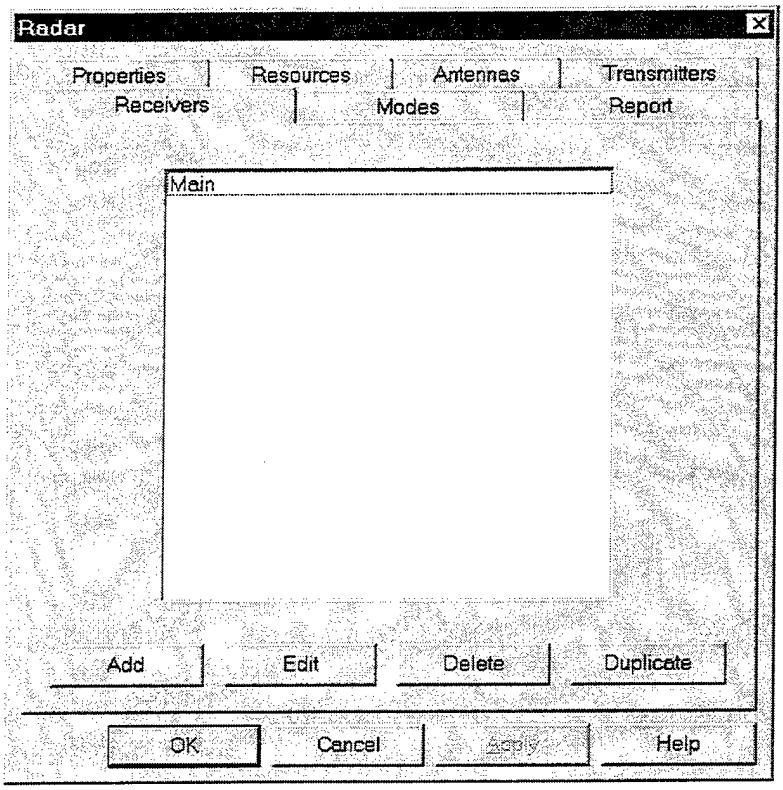

Figure 8-9. Sample of Radar Receivers Dialog Page

1. Editing a Receiver

With a transmitter selected on the list, double-clicking or selecting **Edit** presents the users with the Receiver Properties dialog contains several properties to be edited. Note that operating modes are edited in another dialog. A sample of the Receiver Properties dialog is provided in Figure 8-10.

Name: A text string identifying the transmitter in lists.

Frequency Coverage: Defines the operating frequency range of this receiver (in MHz). A radar could have several receivers, each covering a different frequency range.

This information can be found in the "Pulsed RF" section of the EWIRDB (Tree Number 000000013132).

System Parameters:

- Noise Figure: Enter the noise figure of the receiver (in dB). This information can be found in the "IF" section of the EWIRDB (Tree Number 000000001513).
- System Losses: This is quite often used as a "fudge factor". The users should probably start by entering the receive line loss (if known) and work from there. This is a good parameter to tweak for matching the reported radar detection range.
- False Alarm Rate: The false alarm rate determines the signal-to-noise threshold for this radar. If unknown, a good rule of thumb is to use 1 pulse per microsecond (10^{-6}).

Antenna: Single-click to select an antenna to be used by this receiver. The antennas listed are those that were created on the Radar Antennas page and that have the Receiver property selected. Double-clicking has no effect in this list.

Transmitter: Single-click to select the transmitter paired to this receiver. This tells the receiver model which signal to process. If there are many possible receivers for a single transmitter, simply create several receivers and have each select the same transmitter. The transmitters listed are those that were created on the Transmitters page. Double-clicking has no effect in this list.

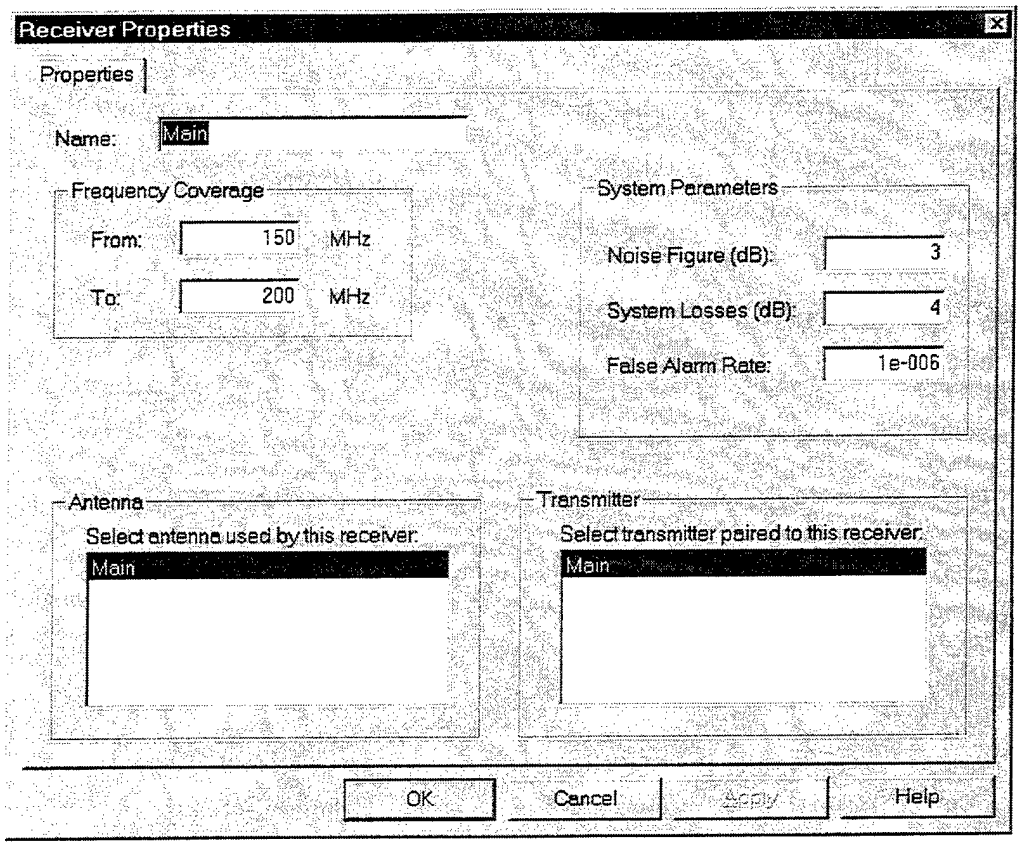

Figure 8-10. Sample of Radar Receiver Properties Dialog Page

F. MODES

The Radar Modes page, as similarly shown in Figure 8-11, contains a list of all modes associated with this radar. Below this list are four buttons described below.

Add: Adds a new, but blank mode object to the radar. It will be shown in the list as "New Mode" and will immediately be opened for editing.

Edit: Opens the currently selected mode for editing. Alternatively, double-clicking the mode in the list will also open the mode.

Delete: Permanently deletes the currently selected mode from the radar object.

Duplicate: Creates a copy of the currently selected mode. It will be listed with the same name as the copied mode plus " (copy)".

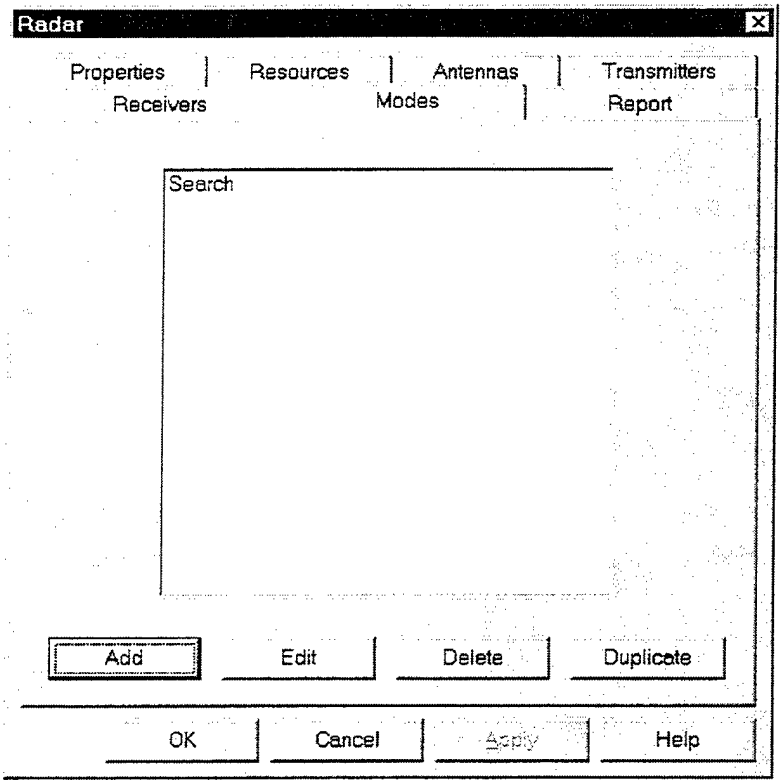

Figure 8-11. Sample of Radar Modes Page

1. Editing a Mode

With a mode selected on the list, double-clicking or selecting **Edit** presents the users with the Radar Mode Properties dialog appears as in Figure 8- 12. There are four pages, one for each component type (antenna, transmitter, and receiver) and a Properties page.

a. Mode Properties

The Radar Mode Properties page, shown in Figure 8-12, contains several properties for the users to specify.

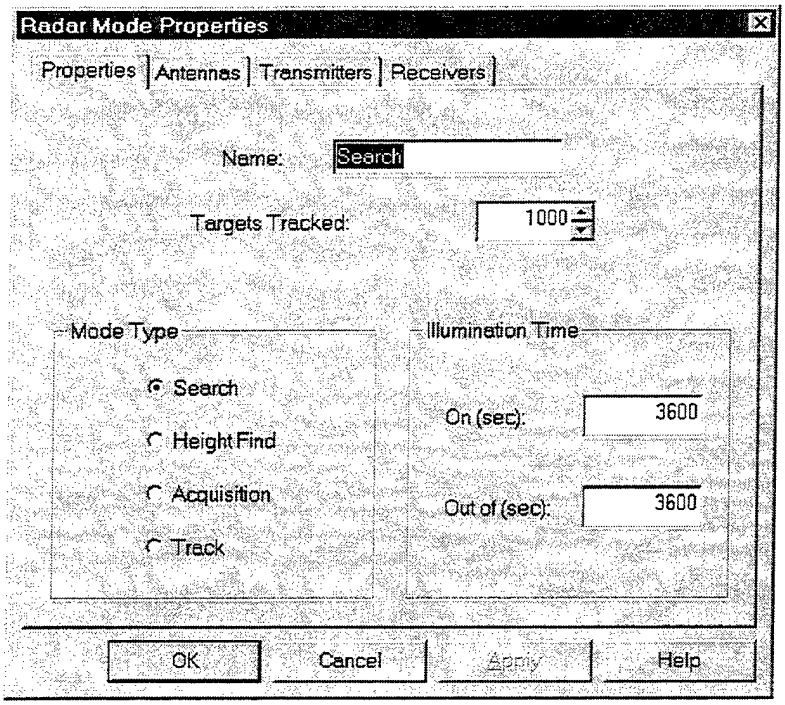

Figure 8-12. Sample of Radar Mode Properties Dialog Page

Name: A text string identifying the mode.

Targets Tracked: This is an arbitrary number defined by the users to represent the maximum number of target this mode can track. The only time this number will matter is if the radar has a tracking mode where multiple targets could be tracked simultaneously (Track While Scan).

Mode Type: Select the radio button indicating the function of this mode. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223).

Illumination Time: This feature is reserved for future use and currently not implemented.

b. Antenna Modes

The Radar Mode Antenna page presents a list of all antennas created on the Radar Antennas page, as similarly shown in Figure 8-13.

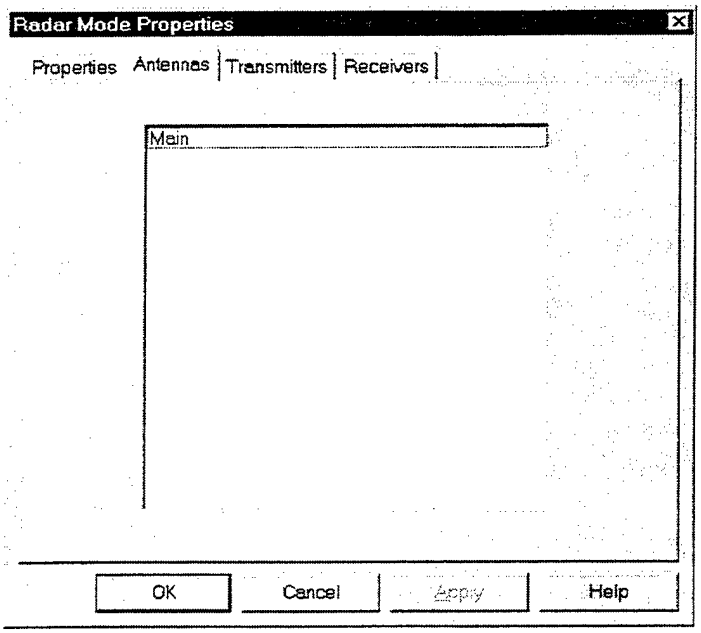

Figure 8-13. Sample of Antenna Mode List Page

Double-clicking a mode name on the list opens the Antenna Mode Properties dialog, as shown in Figure 8-14, for editing the antenna's behavior of the selected mode.

State: Select the radio button indicating whether the users want this antenna to be active or inactive for this mode.

Aimpoint:

- Azimuth: The azimuth aimpoint is significant only for sector scanning radars. It is no impact on circular scans. If this radar is to be attached to an aircraft, then the azimuth aimpoint is ignored since the aircraft will take the aimpoint to be the direction the aircraft is heading (plus azimuth offset).

- Elevation: The elevation aimpoint is significant for all radars. The current position of the beam in elevation is taken to be the elevation aimpoint plus the position of the beam relative to boresight. For example, for a radar with an elevation sector scan of 9 degrees and an elevation beamwidth of 1 degree, setting the elevation aimpoint to 5 degrees will ensure coverage from the horizon (elevation angle of 0) to 10 degrees. For another example, a circular scanning radar with a 20 degree elevation beamwidth aimed -10 degrees from antenna boresight requires an elevation angle of 0 degrees to cover from the horizon to 20 degrees.

- Dynamic Az / El Aimpoint Steering: If these are selected, ARES will dynamically point the sector scanning radars toward a target assigned by a superior communication, command, and control (C3) node.

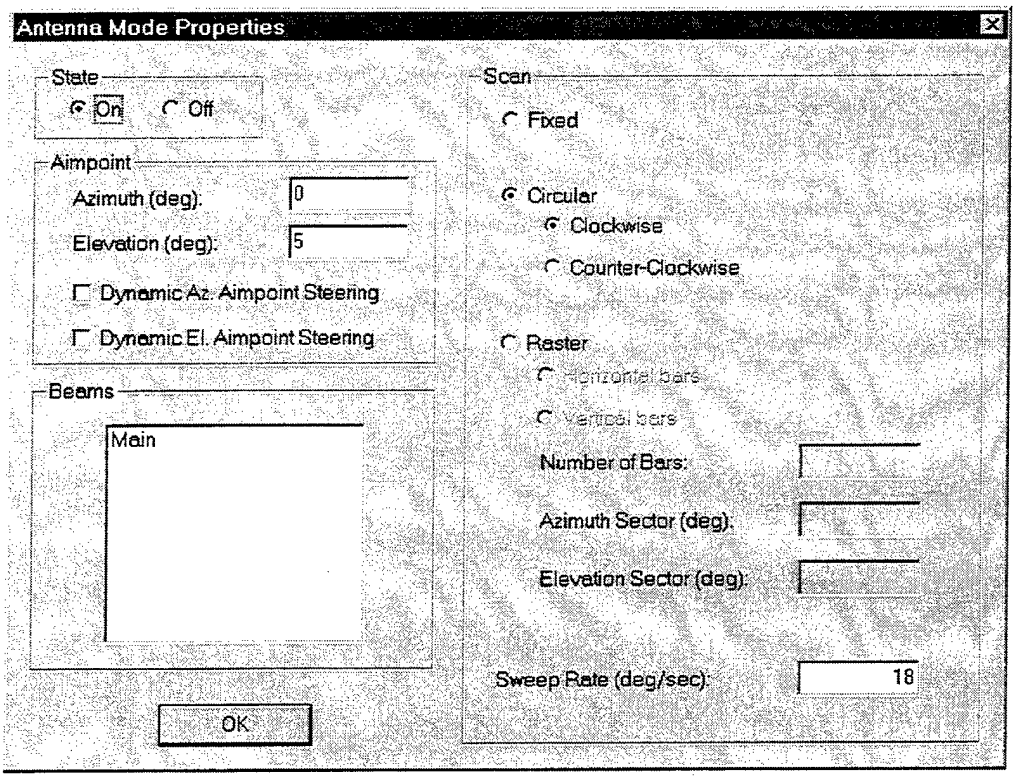

Figure 8-14. Sample of Antenna Mode Properties Dialog Page

Scan:

- Fixed: The antenna does not move.

- Circular: The antenna moves in the direction selected at the Sweep Rate specified. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223).

- Raster: The antenna will raster scan a specified volume of space. The users specify the number of horizontal or vertical bars and the size of the sector to be swept. The actual volume covered by the scan is equal to the sector plus the beamwidth. If only one bar is specified, then the scan will be bi-directional on that bar. The antenna moves at the sweep rate specified. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223).

- Sweep Rate: This is the ratio of scan sector in degree divided by scan period in seconds. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223).

Beams: The beams belonging to this antenna are listed. They can be edited by double-clicking their entry in the list. Upon doing this, the users are presented with the Beam Modes dialog as shown in Figure 8-15.

State: Select the radio button indicating whether the users want this beam to be active or inactive for this mode.

Polarization: Select the radio button indicating all the polarization applicable to this mode from the list. If more than one is selected, ARES will randomly choose a polarization for each iteration. This information can be found in the "Tx / Rx Ant Polarization" section of the EWIRDB (Tree Number 000000001213).

Scan Relative to Antenna:

- Fixed: The beam exhibits no scanning relative to the antenna. The users can specify an azimuth and elevation angle of this beam relative to the antenna boresight.

- Random: If random scanning is selected, ARES will randomly scan the beam throughout the specified azimuth and elevation sector, pausing at each step for the specified beam dwell.

- Vertical: If vertical scanning is selected, ARES will scan the beam unidirectionally from the bottom of the elevation sector. The beam covers the elevation sector using the specified number of beam positions, dwelling at each for the specified time. For example, if a radar has a 3.6 degree azimuth beamwidth and the antenna has a circular scan with a 10 second scan period, then the azimuth beam dwell = 3.6/360*10 = 100 ms. Superimposed on that is an elevation scan to cover a 30 degree sector with a 2 degree elevation beamwidth. To cover the entire elevation sector, the elevation scan over 28 degrees must be completed in 100 ms, meaning that the elevation scan rate will be 280 degrees/sec. To enter this in ARES, the vertical scan on the beam would be used. The elevation sector is 28 degrees. The number of beam positions = sector / elevation beamwidth = 30 /2 =15. The beam dwell is then 100 ms/ 15 = 6.667 ms. By superimposing a vertical beam scan with a circular antenna scan, the users can create "sawtooth" scan patterns which are used by many radars. This information can be found in the "Transmit and Receive Ant" section of the EWIRDB (Tree Number 000000001223).

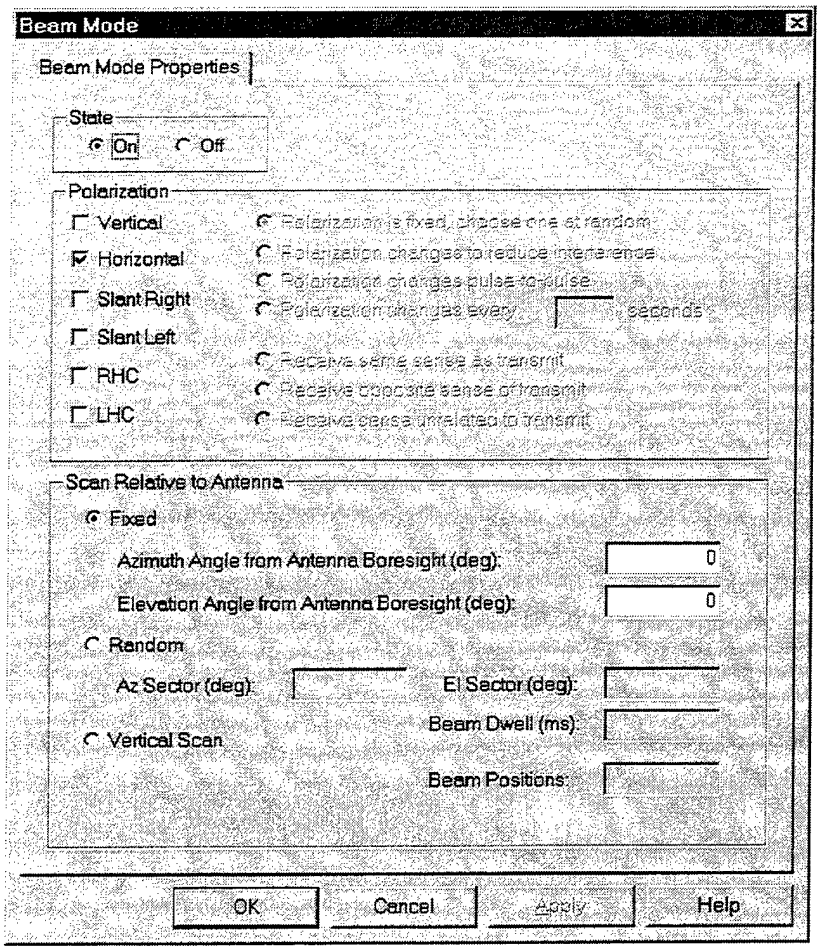

Figure 8-15. Sample of Beam Mode Dialog Page

c. Transmitter Modes

The Radar Mode Transmitter dialog presents a list of all transmitters created on the Radar Transmitters page, as depicted in Figure 8-16. To edit a transmitter's behavior for this mode, double-click its name on the list, whereupon the users are presented with the Modulation dialog as shown in Figure 8-17.

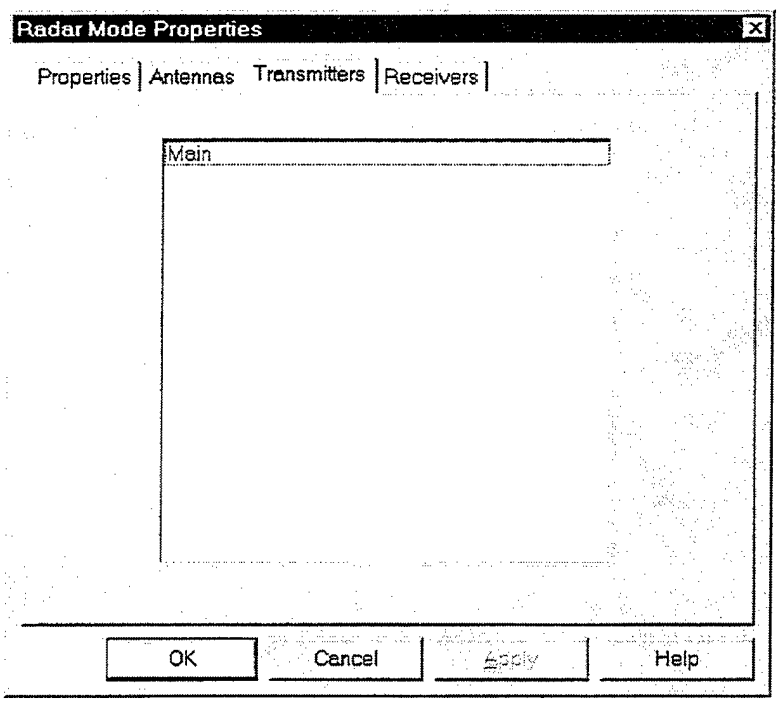

Figure 8-16. Sample of Transmitter Mode List Page

State: Select the radio button indicating whether the users want this transmitter to be active or inactive for this mode.

Frequencies: This information can be found in the "Pulsed RF" section of the EWIRDB (Tree Number 000000013132).

- Continuous: Selecting this button informs ARES that the transmitter can choose any frequency across its entire frequency range for this mode.

- Channelized: Selecting this radio button informs ARES that the transmitter will only use frequencies from the list below. The users add the frequencies to the list (at least one frequency must be in the list).

RF Agility: This information can be found in the "Pulsed RF" section of the EWIRDB (Tree Number 000000013132).

- Fixed: If this button is selected, this transmitter will not change frequency during this mode.

- Pulse-Group to Pulse-Group: If this button is selected, then the transmitter will change frequencies after every pulse-group. The number of pulses in the pulse-group is defined by the inline edit/spin-control.

- Periodic: Periodic agility will result in the transmitter changing frequency at fixed intervals. The change period (in seconds) is defined by the inline edit control. The Equipment Switch Time must also be entered. This is the amount of time (in seconds) that the transmitter will be off-line while the frequency is being switched. For example, if the change period is 60 seconds and the switch time is 10 seconds, then the radar will transmit on a frequency for 50 seconds followed by 10 seconds of dead time, then transmit again on a new frequency. The next frequency selected depends on whether **Continuous** or **Channelized** frequencies were selected. If continuous, then the next frequency will be chosen at random from anywhere in the band. If channelized, then the next frequency will be the next one in the list.

- Manual: If this button is selected, then the radar will change frequency in response to jamming. The Decision Time is the amount of time the operator takes to decide whether to change frequency once jamming is perceived. This time will vary by +/ - 50%. The J/N Threshold is the amount by which the jamming noise (J) must exceed the background noise (N) before it will be recognized by the operator as jamming. The Equipment Switch Time is the amount of time (in seconds) that the transmitter will be off-line while the frequency is being switched. The next frequency selected depends on whether **Continuous** or **Channelized** frequencies were selected. If continuous, then the next frequency will be chosen at random from anywhere in the band. If channelized, then the next frequency will be the next one in the list.

Continuous Wave: Selecting this box informs ARES that this is a continuous wave (CW) signal and does not require pulse width and pulse repetition interval (PRI) to be specified.

Pulse: If this is a pulsed signal, then specify the pulse width (in microseconds) here. Modulation on pulse (MOP) can also be specified here. The choices are no MOP, chirp (enter the chirp slope), or phase coded (enter the number of bits). The MOP parameters entered here are not used to compute processing gain. However, they may be used to tag a signal as having these properties (for example, in a message). These information can be found in the "Pulsed RF and Pulsed Signal Shape" sections of the EWIRDB (Tree Numbers 000000013132 and 000000001311).

PRI: If this is a pulsed signal, then the users have three choices for entering the pulse repetition interval (PRI). The pulses will be generated at the times specified by the PRI entered. This information can be found in the "PRI/PGRI" section of the EWIRDB (Tree Number 000000001312).

- Stable: Enter the stable PRI to be used by this mode.
- Jitter: Enter the average PRI and the percent random deviation.
- Stagger: Enter the legs of a single frame. The PRI legs will be used in the order that the users enter them. When the end of the list is reached, the frame will repeat itself from the top.

d. Receiver Modes

The Radar Mode Receiver dialog presents a list of all receivers created on the Radar Receivers page, as shown in Figure 8-18. To edit a receiver's behavior for this mode, double-click its name on the list. A dialog page as show in Figure 8-19 is presented allowing the users to design the receiver as required.

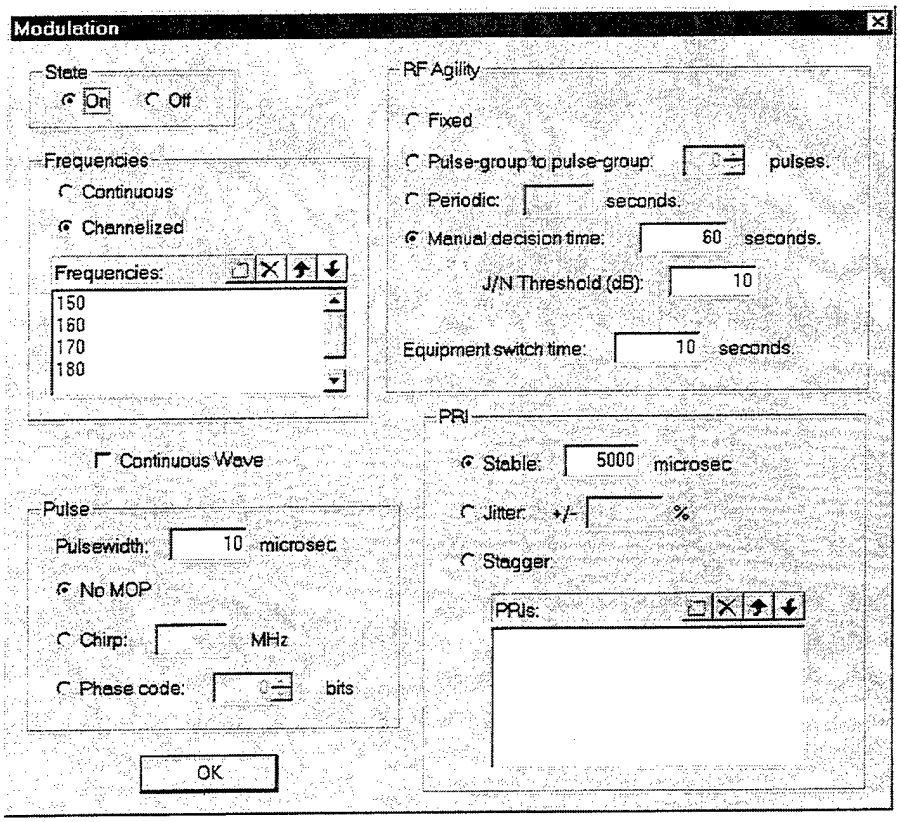

Figure 8-17. Sample of Transmitter Modulation Dialog Page

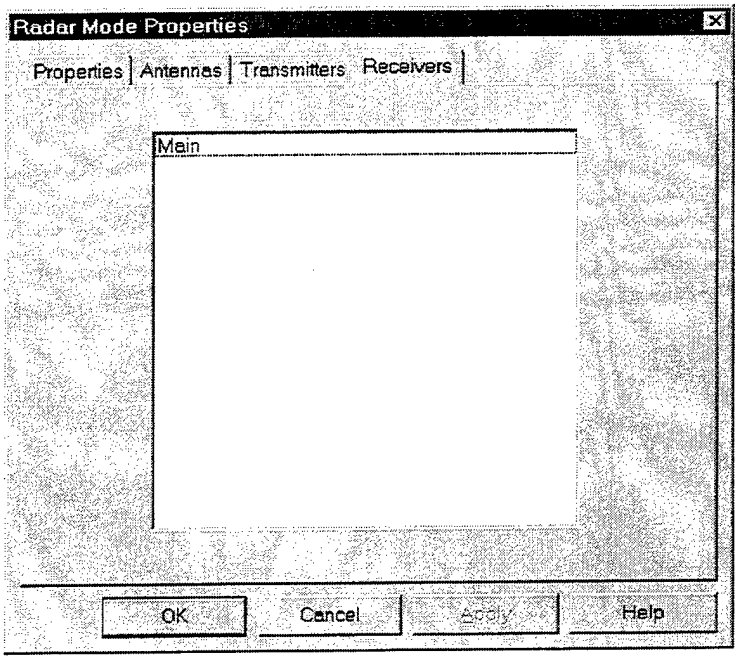

Figure 8-18. Sample of Receiver Mode Dialog Page

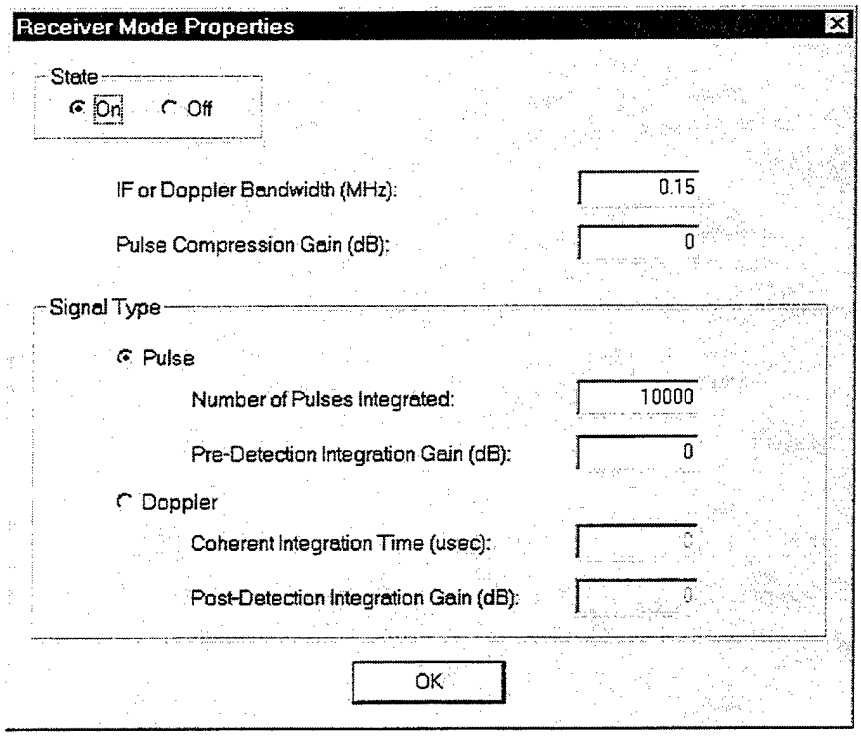

Figure 8-19. Sample of Receiver Mode Properties Dialog Page

State: Select the radio button indicating whether the users want this receiver to be active or inactive for this mode.

IF or Doppler Bandwidth: For a pulsed signal, enter the intermediate frequency (IF) 3-dB bandwidth for the receiver (in MHz). Typically, this is proportional to 1/pulsewidth. For a CW radar, enter the size of the Doppler filters. These information can be found in the "IF" and "Multiple Pulse Processing" sections of the EWIRDB (Tree Numbers 000000001513 and 000000001515).

Pulse Compression Gain: Enter the amount of pulse compression processing gain (e.g., chirp or phase code) credited to this radar. If given, this information can be found in the "Single Pulse Processing" sections of the EWIRDB (Tree Number 000000001514).

Signal Type:

(1) Pulse. Select the radio button indicating the receiver employs pulsed processing.

- Number of Pulses Integrated: Enter the number of pulses to be integrated by the radar receiver in this mode. ARES uses the lesser of this number and the number of pulses generated during the illumination time of the radar, which is the product of pulse repetition frequency (PRF) times beam dwell. If the users want all pulses to be integrated, enter a large number. If given, this information can be found in the "Multiple Pulse Processing" sections of the EWIRDB (Tree Number 000000001515).

- Pre-Detection Integration Gain: Enter the amount of pre-detection integration gain credited to this radar. ARES will boost the pulse S/N ratio by the specified amount. If given, this information can be found in the "Multiple Pulse Processing" sections of the EWIRDB (Tree Number 000000001515) if given.

(2) Doppler. Select the radio button indicating the receiver employs Doppler processing.

- Coherent Integration Time: Enter the amount of time interval this radar integrates over. This information can be found in the "Multiple Pulse Processing" sections of the EWIRDB (Tree Number 000000001515) if given.

- Post-Detection Integration Gain: Enter the amount of post-detection integration gain credited to this radar. ARES will boost the pulse S/N ratio by the specified amount. This information can be found in the "Multiple Pulse Processing" sections of the EWIRDB (Tree Number 000000001515) if given.

G. REPORT

The Radar Report page, as shown in Figure 8-20, contains a list of information that can be transmitted by this radar over a network. If the **Publish** radio button is selected, then players using this radar will offer the selected information to any networks of which it is a member (see Chapter XII). The information offered is described below.

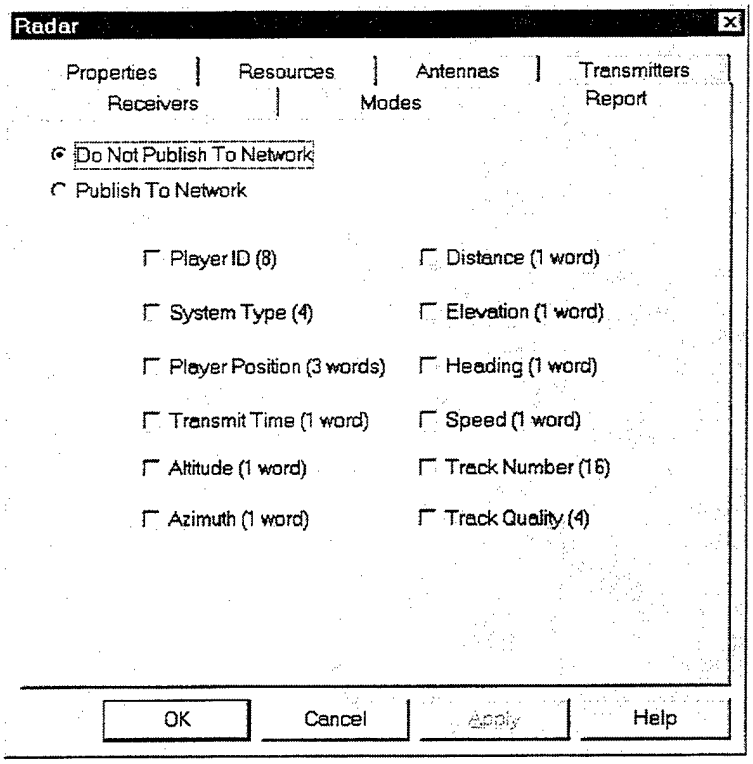

Figure 8-20. Sample of Radar Publish Dialog Page

Player ID: This is an 8-bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

System Type: This is a 4-bit parameter identifies the type of the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

Player Position: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying the player's current position.

Transmit Time: This is a single word that identifies the time at which the packet was created. Select this if the users want each packet to have a time-stamp indicating the age-of-the information to its recipients.

Altitude: This is a single word representing the altitude of the track which is being reported in this packet. Selecting this parameter implies that the radar has the ability to resolve and report altitude (i.e., it is either a 3-D radar or a height-finder).

Azimuth: This is a single word representing the azimuth angle of the reported track.

Distance: This is a single word representing the distance of the reported track.

Elevation: This is a single word representing the elevation angle of the reported track.

Heading: This is a single word representing the heading of the reported track. Selecting this parameter implies that the radar has the ability to resolve and report the heading of the track.

Speed: This is a single word representing the speed of the reported track. Selecting this parameter implies that the radar has the ability to resolve and report the speed of the track.

Track Number: This is a 16-bit parameter representing the locally assigned track number.

Track Quality: This is a 4-bit parameter representing the quality of the track.

H. MULTI BEAM RADAR CONSIDERATION

For radar with simultaneous multi-beams, there are two approaches to modeling. Typically, multi-beam radar can discriminate either in frequency or direction of arrival which beam the target is being returned from. In case of each beam is a different frequency, the approach is to model the radar as a collection of separate antennas, one for each beam. In case the beams are stacked in elevation, the radar can be modeled as one antenna consisted of multiple beams, each with different aimpoint and scan sector.

For radars with two sequential beams, the users should cut the scan rate in half in order to preserve the scan period. This results in twice the number of pulses on target. The users can accommodate this by either adding 3 dB of system losses or limiting the number of pulses integrated to the appropriate number. The number of pulses integrated is product of PRF times beam dwell.

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IX. EDITING AN ESM SYSTEM

An ESM system in the Systems tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 9-1 which features six pages: **Properties**, **Resources**, **Antennas**, **Receivers**, **Modes**, and **Publish**. To build an ESM system, the users will have to create all of its components and then describe their operation using the **Modes** page. If this system is to participate on a network, the users can identify the information it can provide to a network on the **Publish** page.

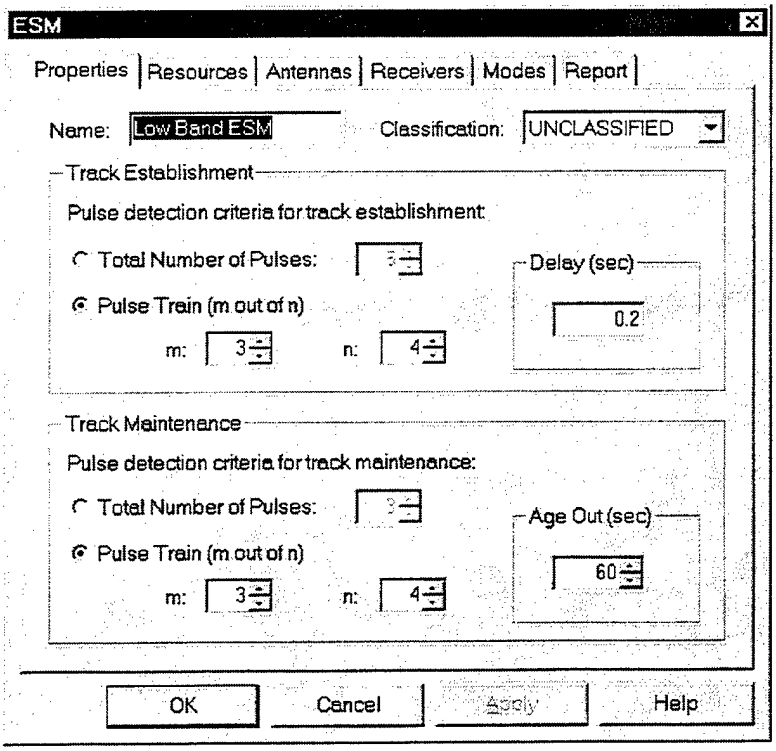


Figure 9-1. Sample of ESM Properties Dialog Page

A. PROPERTIES

The ESM Properties page, as shown in Figure 9-1, contains four fundamental blocks of information. These are described in detail below.

Name: This is a text string that is used to identify the ESM throughout ARES. It is displayed under ESM folder on the Systems tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for ESMs.

Classification: The users can select the classification level of the ESM from the drop-down list. The classification is used only for reference in the dialog.

Track Establishment: This block is where the users indicate the criteria that ARES will use for the ESM to establish an active track of a target. The users can choose a criteria based on the total number of pulses received from an emitter, or based on m-out-of-n pulses detected in a pulse train. The total number of pulse criteria will count the pulses over multiple dwells, while the pulse-train criteria will examine only the pulses in a single dwell.

The delay is a fixed amount of time that the users specify to account for processing delays before this track can be declared.

Track Maintenance: This block is where the users specify the criteria to maintain the active status of an already established track. If the criteria is not met, then the track will not be updated.

The age-out is the amount of time that must elapse since the last update before a track will be declared inactive. For example, with an age-out of 60 seconds, if an emitter was last seen (i.e., its track maintenance criteria was last met) at T = 1500 seconds, then the track will be declared inactive at T = 1560 seconds unless updated again before that time.

B. RESOURCES

This page, shown in Figure 9-2, is an optional advanced feature in ARES and is designed for special application in GA. Unless the users are knowledgeable about the defined system, this page can be ignored. In general, this page allows the users to specify the size, weight, and support requirements for the ESM system, which in turn is used for consideration in GA system selection process. If the GA develops a solution where the systems require more resources (the sum of their required resources) than the allowed maximum values for the platform as defined in the GA constraints page from the Templates page, then the GA will simply "turn off" that platform (i.e., not use it).

C. ANTENNAS

The ESM Antennas page, as shown in Figure 9-3, contains a list of all antennas associated with this ESM system. Below this list are four buttons described below.

Add: Adds a new, but blank antenna object to the ESM. It will be shown in the list as "New Antenna" and will immediately be opened for editing.

Edit: Opens the currently selected antenna for editing. Alternatively, double-clicking the antenna in the list also opens the antenna.

Delete: Permanently deletes the currently selected antenna from the ESM object.

Duplicate: Creates a copy of the currently selected antenna. It will be listed with the same name as the copied antenna plus " (copy)".

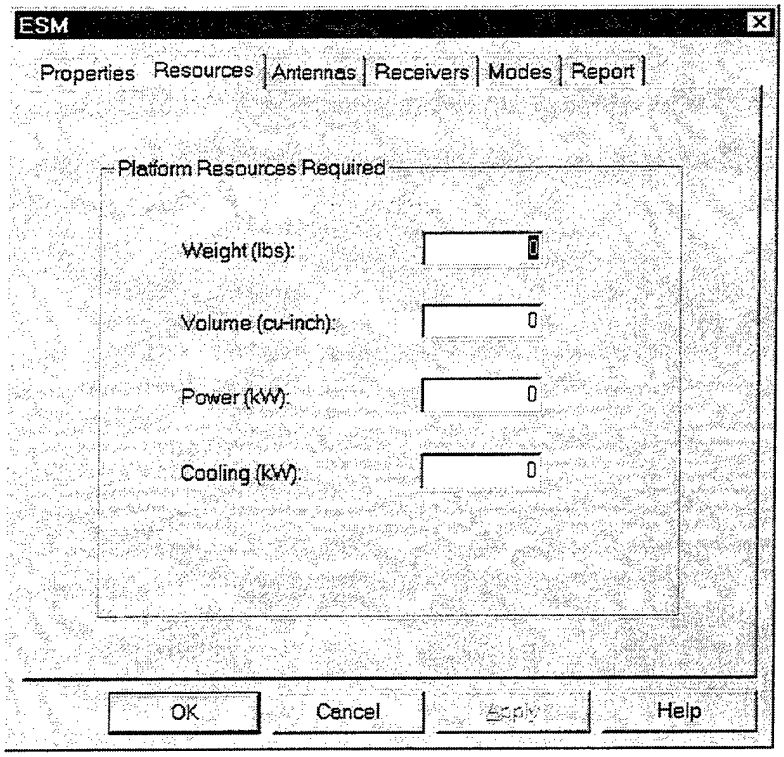


Figure 9-2. Sample of ESM Resources Dialog Page

1. Editing an Antenna

With an antenna selected on the list, double-clicking or selecting **Edit** presents the users with a Properties page contains several properties to be edited. A sample of ESM Antenna Properties page is provided in Figure 9-4.

Name: A text string identifying this antenna in lists.

Scan Rate: This is the ratio of scan sector in degrees divided by scan period in seconds. At present, ESMs that scan do so with a circular pattern only; hence the users should use 360 degrees for scan sector.

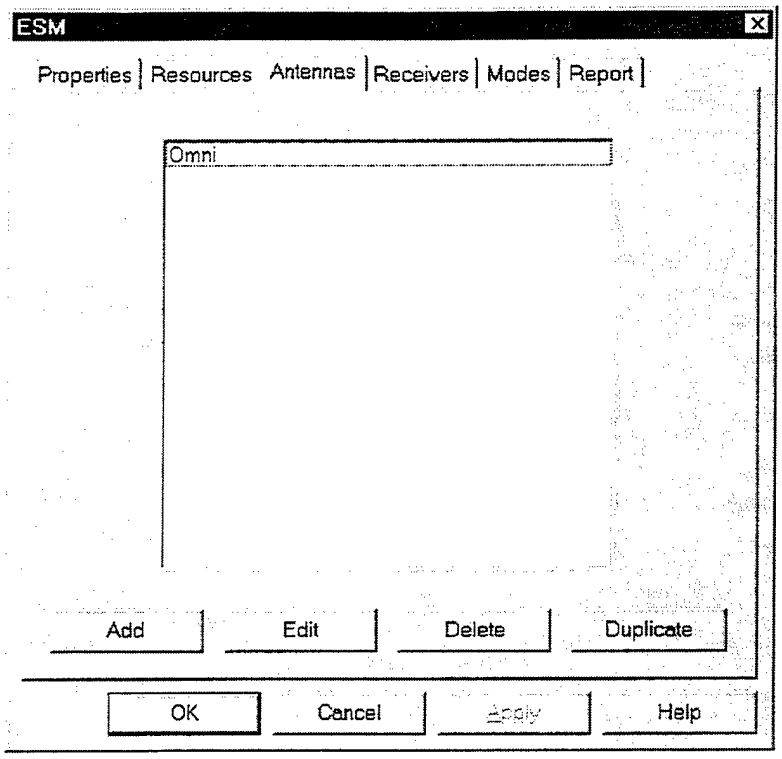


Figure 9-3. Sample of ESM Antennas Dialog Page

Angular Offset: The angular offset is used for describing the mounting of this antenna relative to the local "front". For example, a side-looking radar mounted on the right side of an aircraft would have an azimuth offset of 90 degrees. A rear facing radar would have an azimuth offset of 180 degrees. The angular offset does not describe scan or aiming sector. It is simply an offset relative to the platform on which the antenna is mounted.

Edit Beam: Button, when depressed, opens a dialog, shown in Figure 9-4, that contains several properties to be edited as defined below.

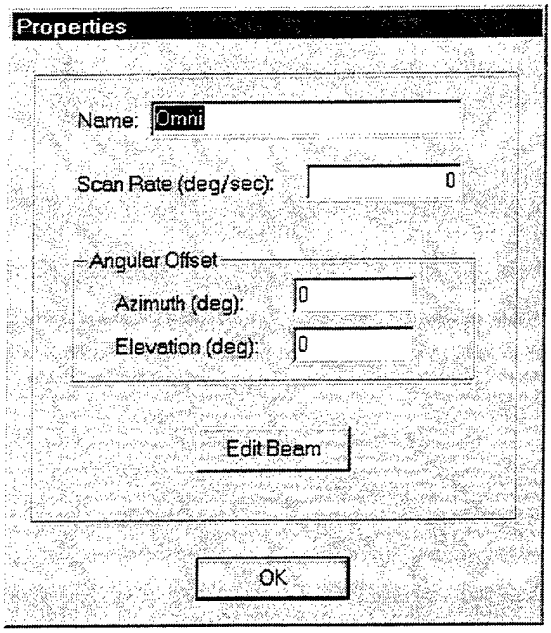


Figure 9-4. Sample of ESM Antenna Properties Dialog Page

Name: This is a text string identifying this beam in lists.

Transmit / Receive: ARES allows the users to specify beam properties for receive.

- Mainbeam Gain: This is the gain (in dB) associated with this beam. If it is not given, this value can be calculated using equation below where θ_a and θ_e are the 3-dB azimuth and elevation beamwidths in radians.

$$G \cong \frac{4\pi}{\theta_a \theta_e} \tag{9.1}$$

- Azimuth / Elevation Beamwidth: This is the 3-dB azimuth and elevation beamwidths in degrees of this beam.

Sidelobes: The users have the option of identifying a particular antenna pattern to associate with this beam, or the users can choose to have no pattern. The patterns available to the users are those that were created under the Signatures tab. For this reason, the users should create the signatures before create the systems. If the users

chooses no sidelobes, ARES uses 0 dBi (isotropic) to represent all values outside of the mainbeam.

D. RECEIVERS

The Receivers page, as shown in Figure 9-6, contains a list of all receivers associated with this ESM system. Below this list are four buttons described below.

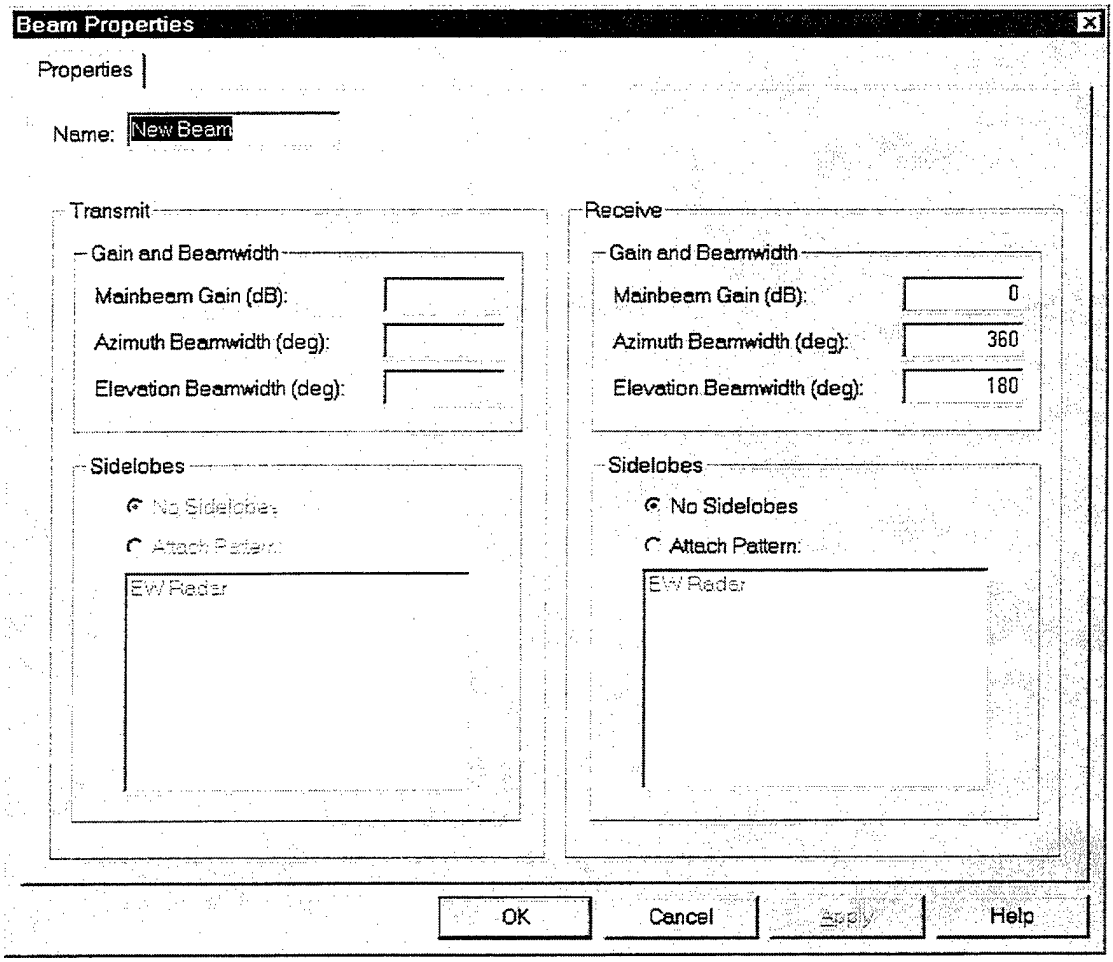


Figure 9-5. Sample of ESM Antennas Beam Properties Dialog Page

Add: Adds a new, but blank receiver object to the ESM. It will be shown in the list as "New Receiver" and will immediately be opened for editing.

Edit: Opens the currently selected receiver for editing. Alternatively, double-clicking the receiver in the list also opens the receiver.

Delete: Permanently deletes the currently selected receiver from the ESM object.

Duplicate: Creates a copy of the currently selected receiver. It will be listed with the same name as the copied receiver plus " (copy)".

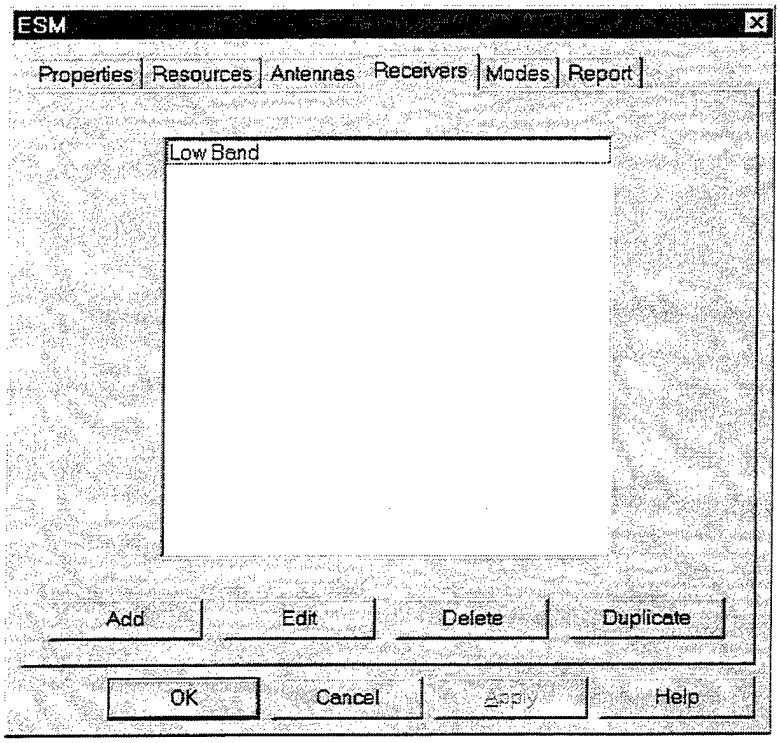


Figure 9-6. Sample of ESM Receiver List Dialog Page

1. Editing a Receiver

With a receiver selected on the list, double-clicking or selecting **Edit** presents the users with a Receiver Properties dialog containing two pages as depicted in Figure 9-7. Description of each page is as follows.

a. Properties

This page, as shown in Figure 9-7, contains several receiver properties to be edited as described below.

Name: This is a text string identifying this receiver in lists.

Receiver Type: Select the radio button indicating the type of this receiver. A superhet will have one filter, while a channelizer is effectively multiple filters (like multiple superhets).

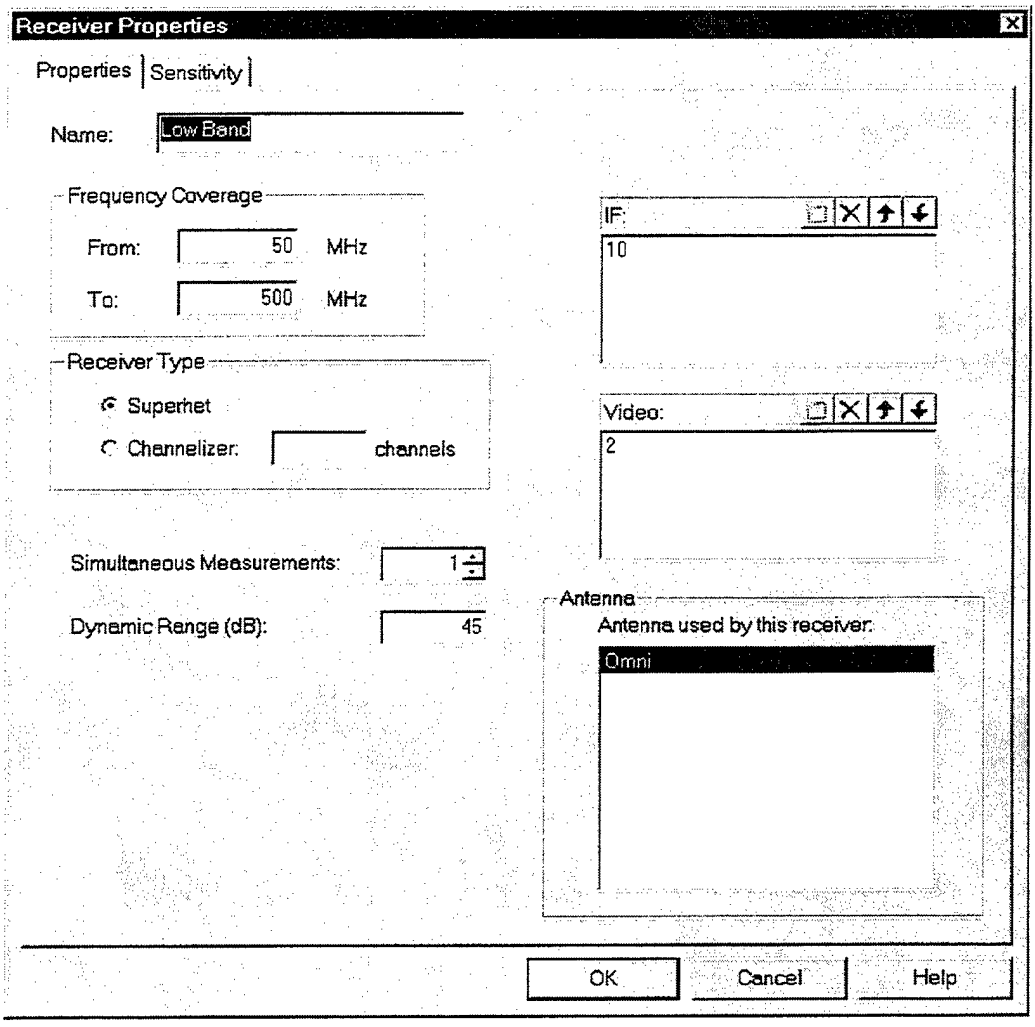


Figure 9-7. Sample of ESM Receiver Properties Dialog Page

Simultaneous Measurements: Defines the number of simultaneous measurements that ARES internal receiver model can process in pulse-on-pulse situations. For example, if a receiver is specified to handle only 1 simultaneous measurement and two filters have a pulse simultaneously, then only one of the pulses will be measured and the other is lost.

Dynamic Range: Determines the range of signal strenght that the receiver can "see". For example, if the sensitivity is –100 dBm and the dynamic range is 60 dBm, then signals between –100 and –40 dBm will be received.

IF: Defines the instantaneous bandwidth of the front end receiver.

Video: Defines the bandwidth of the detector. The narrower this is, the more sensitive the receiver but at the cost of minimum detectable pulsewidth.

Antenna: Single-click to select an antenna to be used by this receiver. The antennas listed are those that were created on the ESM Antennas page. Double-clicking has no effect in this list.

b. Sensitivity

This page, as shown in Figure 9-8, contains eight properties of which six are editable as described below.

Frequency: This is an arbitrary frequency defined by the users representing an independent variable for the sensitivity calculation.

NF: Defines the noise figure at this frequency.

Bn: Defines the noise bandwidth for this ESM. Usually this is the same as the video bandwidth.

SNR: Defines the threshold signal-to-noise-ratio for this ESM.

Install Gain / Loss: Defines any pertinent installation gains or losses (e.g., due to amplifiers, long lengths of coax., etc.)

Mainlobe Gain: This value is internally calculated by ARES.

Calculated Sensitivity: This value is internally calculated by ARES.

User Sensitivity: The user sensitivity is the number that ARES will actually use for the selected ESM. The users can edit this column to overide the other calculations on this page.

E. MODE

The Modes page, as similarly shown in Figure 9-9, contains a list of all modes associated with this ESM system. Below this list are four buttons described below.

Add: Adds a new, but blank mode object to the ESM. It will be shown in the list as "New Mode" and will immediately be opened for editing.

Edit: Opens the currently selected mode for editing. Alternatively, double-clicking the mode in the list will also open the mode.

Delete: Permanently deletes the currently selected mode from the ESM object.

Duplicate: Creates a copy of the currently selected mode. It will be listed with the same name as the copied mode plus " (copy)".

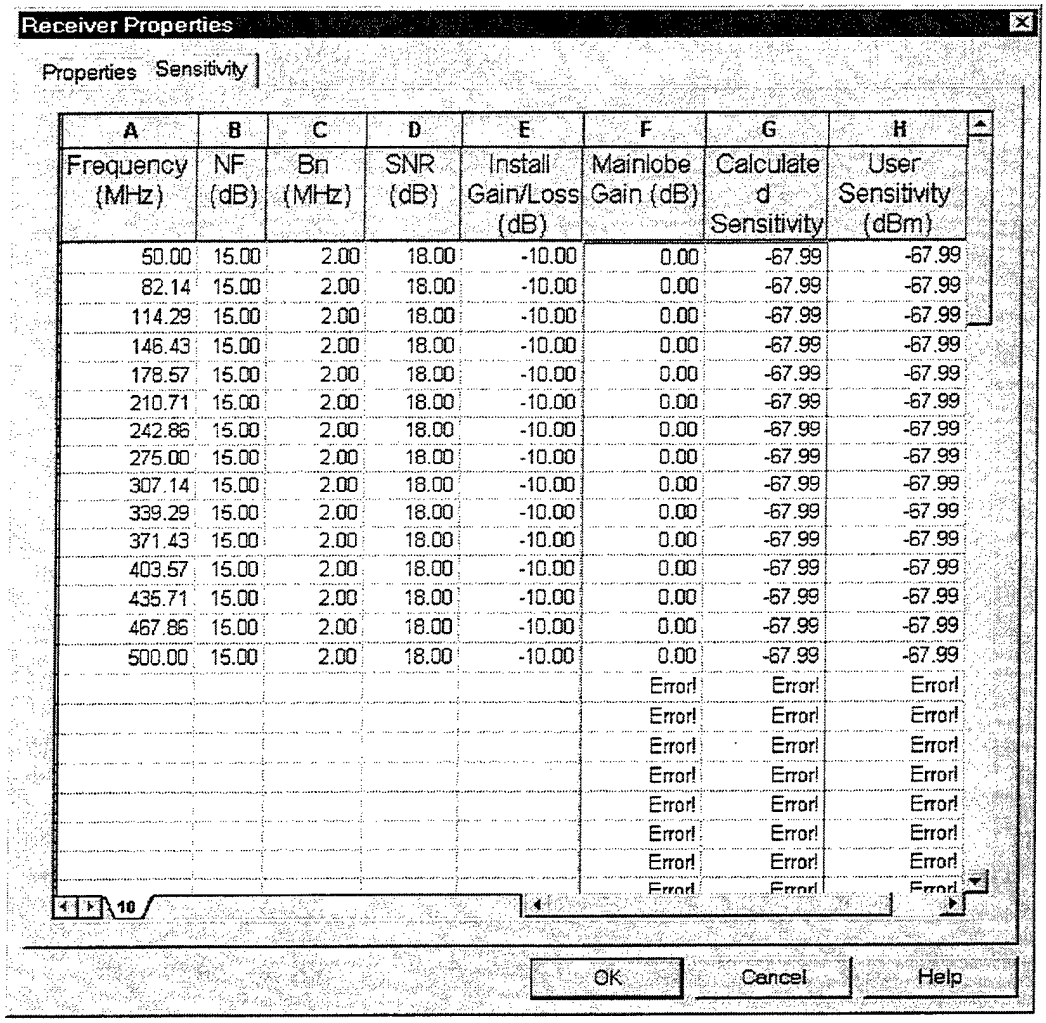


Figure 9-8. Sample of ESM Receiver Sensitivity Dialog Page

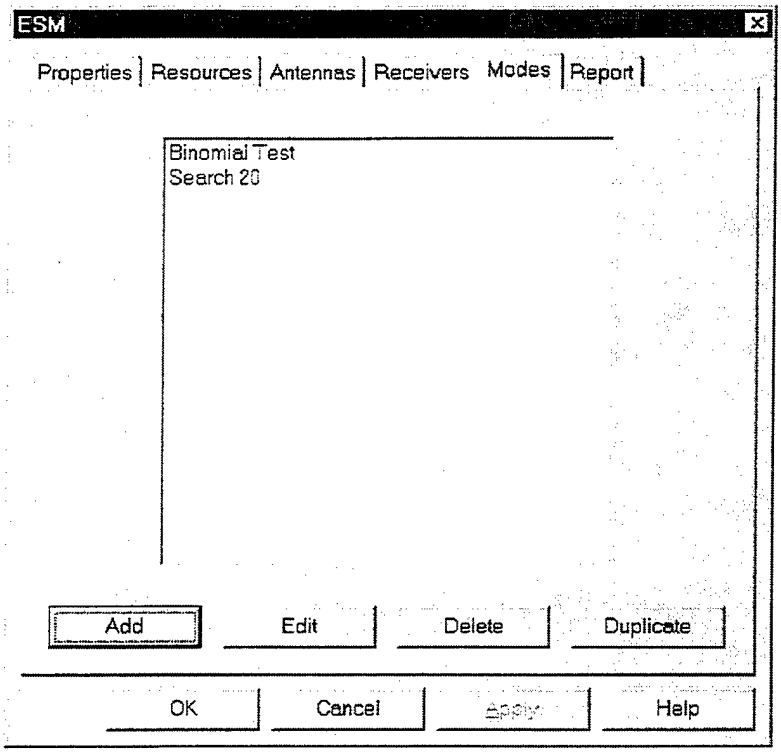


Figure 9-9. Sample of ESM Modes Dialog Page

1. Editing a Mode

With a mode selected on the list, double-clicking or selecting **Edit** presents the users with the ESM Mode Properties dialog appears as in Figure 9- 10. There are three pages as described below.

a. Mode Properties

The ESM Mode Properties page contains only a single entry for the users to specify the name of the mode.

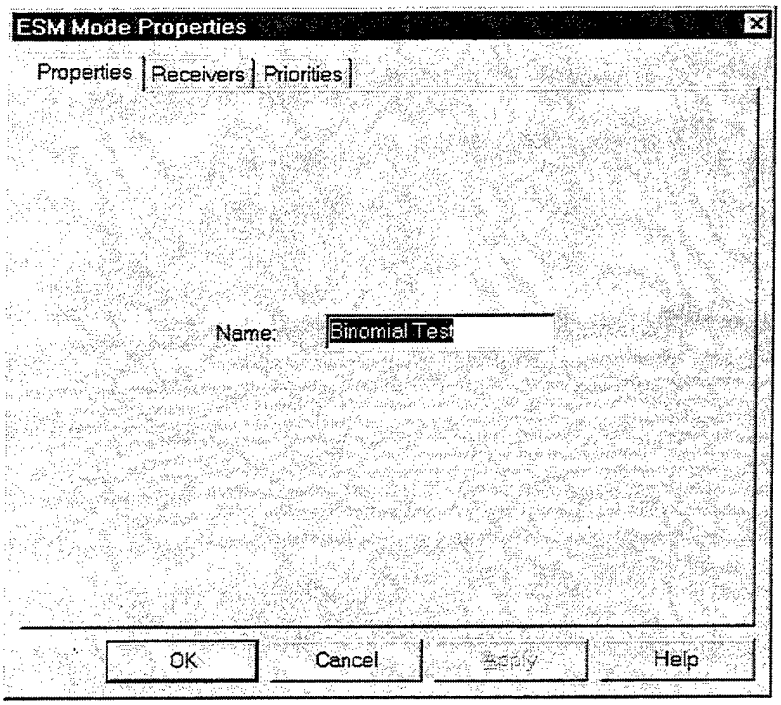


Figure 9-10. Sample of ESM Modes Properties Dialog Page

b. Receiver Modes

The ESM Modes Receiver page, as similarly shown in Figure 9-11, contains a list of all receivers associated with this ESM system. With a receiver selected on the list, double-clicking presents the users with the Receiver Tune Schedule dialog, as appeared in Figure 9-12, which contains 10 properties to be defined as described below.

RF Low / High: Defines the tuning frequency coverage for the receiver to "open" and collecting data.

Az High / Low: Defines the instantaneous azimuthal coverage for this tune.

Delta Sensitivity: Defines the enhancements to the sensitivity that were not included on the reciever sensitivity page.

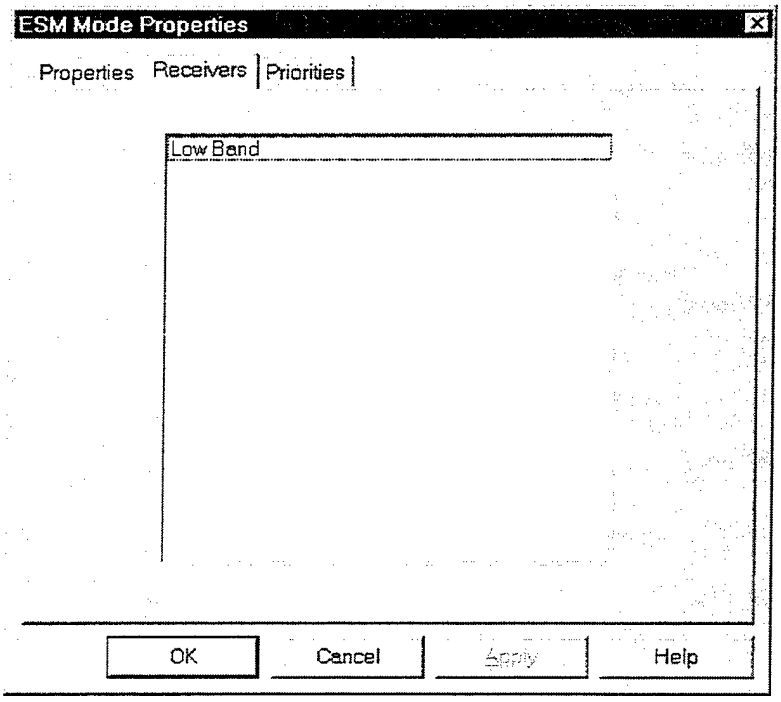


Figure 9-11. Sample of ESM Modes Receivers Dialog Page

Sensitivity: This is internally determined by ARES.

Polarization: Single-click opens a pull-down menu allowing the users to select the polarization for the select tune. Tuning co-pol will result in 0 dB loss. Cross-pol will result in 25 dB loss.

Shadow Time: Defines the minimum amount of time that the receiver is tied up to measure a pulse, starting from the leading edge of that pulse. This is important in assessing pulse-on-pulse conditions. The users can use the Poisson distribution to assess the probability that two pulses overlap. As long as they do not overlap within the shadow time, there is no pulse-on-pulse condition.

Dwell: Defines the duration of time that the receiver is actually "open" and collecting data. It is typically set long enough to guarantee that intercept will happen

within a given length of time, but not so long duty cycle constraints are at risk. For example, if detection criteria is that 3 out of 4 pulses must be intercepted in a pulse train, then the dwell must be equivalent to at least 3 PRI of the emitters of interest in order to guarantee that 3 pulses were intercepted in a given collection.

Revisit Time: Defines the amount of time that passes before this tune will take another dwell. Presumably, during the period of time that elapses between dwells the receiver is off making dwells of other tunes in the schedule.

The dwell time and revisit time go hand in hand. For each tune, the duty cycle equals the dwell time divided by the revisit time. So, a larger duty cycle would be expected to result in faster detection. Summing the duty cycles for all of the tunes give the overall receiver duty cycle.

c. Priorities

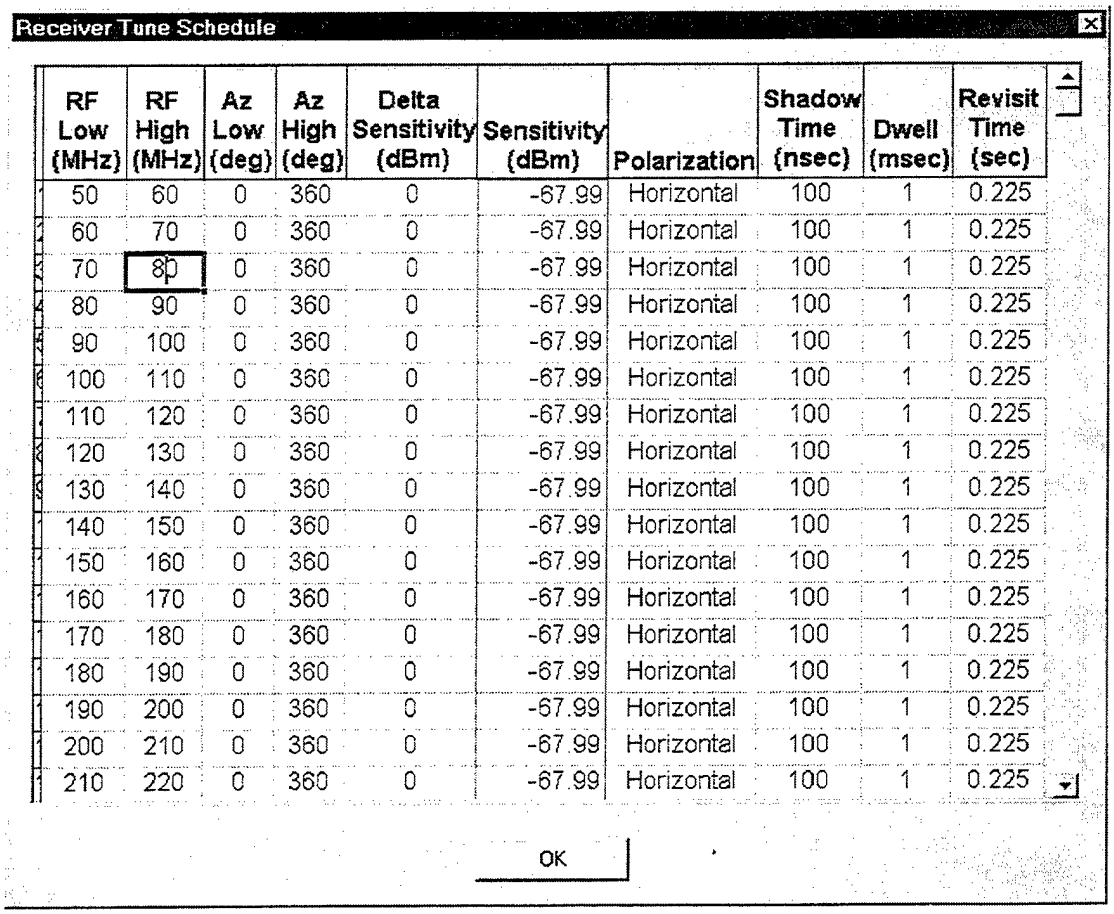
The ESM Modes Priorities dialog, shown in Figure 9-13, is used to define which ESM detections should go to the front of the queue for transmission via a network. It consists of two columns of which one is editable as described below.

Radar: Contains a list of radar systems created under Systems Tab of which the operating frequency is within the selected ESM receiver frequency coverage.

Priority: Defines the network transmission priority for the ESM detection of the listed radars. A priority can be assigned by single-click the cell to activate the pull-down menu for selection. There are 3 types of priority as decribed below.

- High: Signifies first in the queue to be transmitted.
- Normal: Signifies second in the queue to be transmitted.

- Low: Signifies last in the queue to be transmitted.



RF Low (MHz)	RF High (MHz)	Az Low (deg)	Az High (deg)	Delta Sensitivity (dBm)	Sensitivity (dBm)	Polarization	Shadow Time (nsec)	Dwell (msec)	Revisit Time (sec)
50	60	0	360	0	-67.99	Horizontal	100	1	0.225
60	70	0	360	0	-67.99	Horizontal	100	1	0.225
70	80	0	360	0	-67.99	Horizontal	100	1	0.225
80	90	0	360	0	-67.99	Horizontal	100	1	0.225
90	100	0	360	0	-67.99	Horizontal	100	1	0.225
100	110	0	360	0	-67.99	Horizontal	100	1	0.225
110	120	0	360	0	-67.99	Horizontal	100	1	0.225
120	130	0	360	0	-67.99	Horizontal	100	1	0.225
130	140	0	360	0	-67.99	Horizontal	100	1	0.225
140	150	0	360	0	-67.99	Horizontal	100	1	0.225
150	160	0	360	0	-67.99	Horizontal	100	1	0.225
160	170	0	360	0	-67.99	Horizontal	100	1	0.225
170	180	0	360	0	-67.99	Horizontal	100	1	0.225
180	190	0	360	0	-67.99	Horizontal	100	1	0.225
190	200	0	360	0	-67.99	Horizontal	100	1	0.225
200	210	0	360	0	-67.99	Horizontal	100	1	0.225
210	220	0	360	0	-67.99	Horizontal	100	1	0.225

Figure 9-12. Sample of ESM Modes Receivers Tune Schedule Dialog

F. REPORT

The Report page, as shown in Figure 9-14, contains a list of information that can be transmitted by this ESM over a network. If the **Publish** radio button is selected, then players using this ESM will offer the selected information to any networks of which it is a member (see Chapter XII). The information offered is described below.

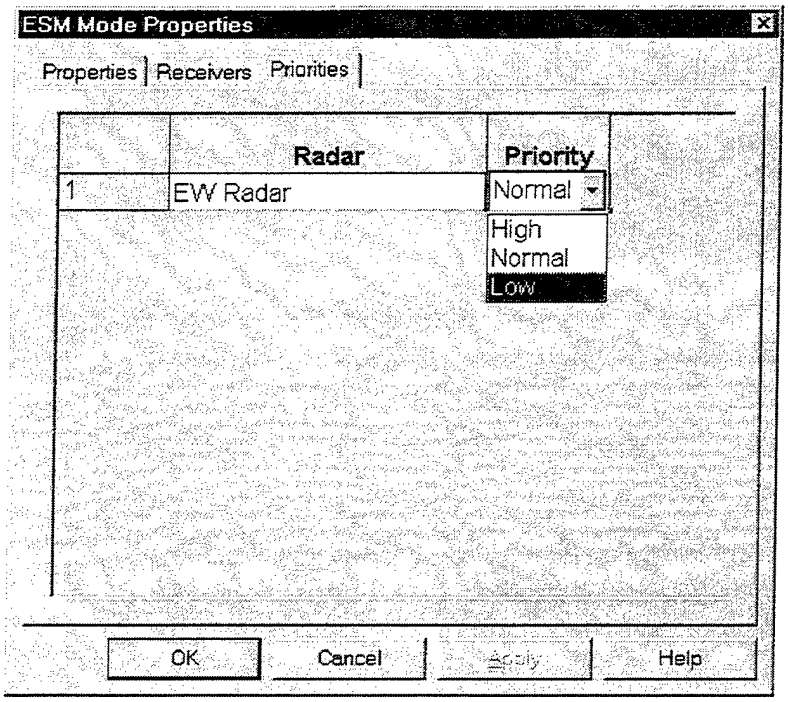


Figure 9-12. Sample of ESM Modes Receivers Tune Schedule Dialog

Player ID: This is an 8-bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

System Type: This is a 4-bit parameter identify the type of the player to the network.

Player Position: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying the player's current position.

Transmit Time: This is a single word that identifies the time at which the packet was created. Select this if the users want each packet to have a time-stamp indicating the age-of-the information to its recipients.

Altitude: This is a single word representing the altitude of the detected emitter which is being reported in this packet. Selecting this parameter implies that the ESM has the ability to resolve and report altitude.

Average PRI: This is a single word representing the average PRI of the reported emitter.

Azimuth AOA: This is a single word representing the azimuth angle of arrival of the reported emitter.

Classification: This is 32-bit parameter uniquely identifying the classification of the reported emitter.

Elevation AOA: This is a single word representing the elevation angle of arrival of the reported emitter.

FMOP: This is a single word representing the frequency modulation on pulse (e.g., chirp) of the reported emitter.

Frequency: This is a single word representing the frequency of the reported emitter. If there are multiple frequencies, then one word will be generated per frequency.

Latitude: This is a single word representing the latitude of the reported emitter.

Longitude: This is a single word representing the longitude of the reported emitter.

Mode: This is 8-bit parameter uniquely identifying the mode of the reported emitter.

On/Off State: This is a single word representing the status of the reported emitter (on or off).

Phase MOP: This is a single word representing the phase coded waveforms (e.g. barker code) of the reported emitter.

PRI: This is a single word representing the PRI of the reported emitter. If there are multiple PRI, then one word will be generated per PRI.

Pulse Width: This is a single word representing the pulse width of the reported emitter.

SEI: This is a 32-bit parameter representing the unique identification of the emitter (if the receiver has SEI capability).

SEI Match Number: This is a single word representing the quality of the identification.

SEI Parameters: This is 16 words representing the uniquely computed coefficients that were used to determine identification.

Track Number: This is a 16-bit parameter representing the locally assigned track number.

Track Quality: This is a 4-bit parameter representing the quality of the track.

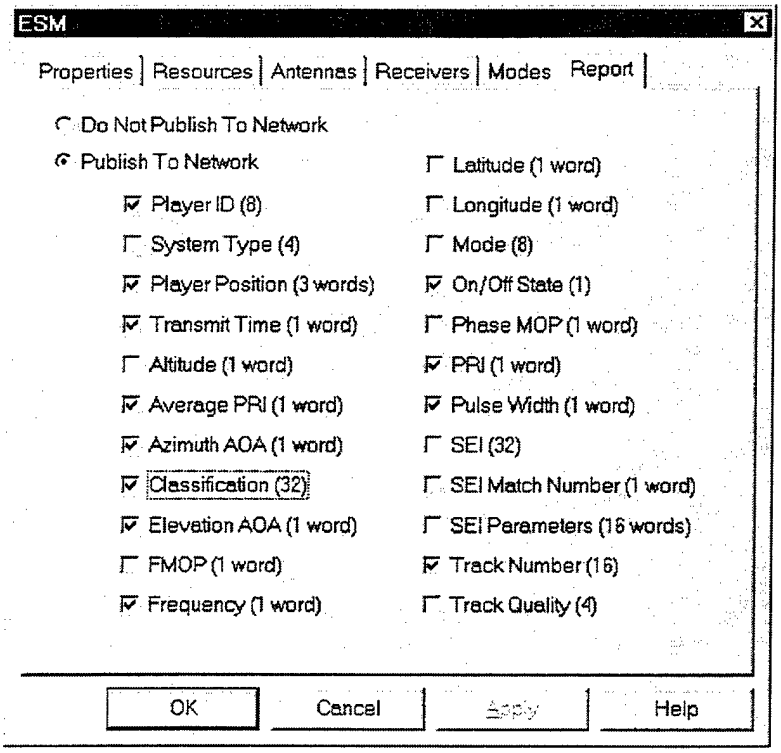


Figure 9-14. Sample of ESM Publish Dialog Page

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X. EDITING AN ECM SYSTEM

An ECM system in the Systems tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 10-1 which features five pages: **Properties**, **Resources, Transmitters**, **Modes**, and **Publish**. To build an ECM system, the users will have to create its components and then describe their operation using the **Modes** page. If this system is to participate on a network, the users can identify the information it can provide to a network on the **Publish** page.

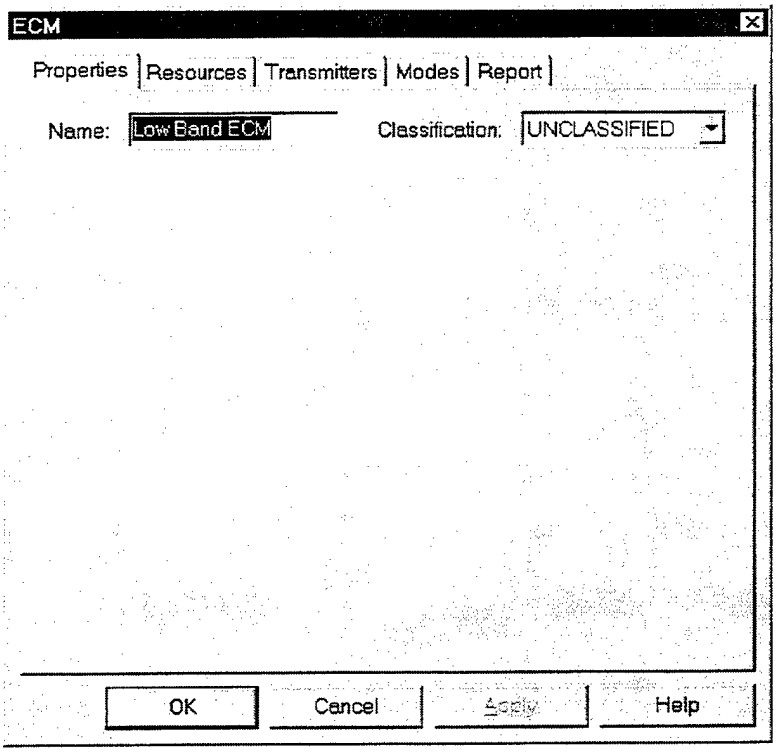

Figure 10-1. Sample of ECM Properties Dialog Page

A. PROPERTIES

The ECM Properties page, as shown in Figure 10-1, contains two fundamental blocks of information. These are described in detail below.

Name: This is a text string that is used to identify the ESM throughout ARES. It is displayed under ESM folder on the Systems tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for ESMs.

Classification: The users can select the classification level of the ESM from the drop-down list. The classification is used only for reference in the dialog.

B. RESOURCES

This page, shown in Figure 9-2, is an optional advanced feature in ARES and is designed for special application in GA. Unless the users are knowledgeable about the defined system, this page can be ignored. In general, this page allows the users to specify the size, weight, and support requirements for the ECM system, which in turn is used for consideration in GA system selection process. If the GA develops a solution where the systems require more resources (the sum of their required resources) than the allowed maximum values for the platform as defined in the GA constraints page from the Templates page, then the GA will simply "turn off" that platform (i.e., not use it).

C. TRANSMITTERS

The Transmitters page, shown in Figure 10-3, contains a list of all transmitters associated with this ECM system. Below this list are four buttons described below.

Add: Add a new, but blank transmitter object to the ECM. It will be shown in the list as "New Transmitter" and will immediately be opened for editing.

Edit: Opens the currently selected transmitter for editing. Alternatively, double-clicking the transmitter in the list also opens the transmitter.

Delete: Permanently deletes the currently selected transmitter from the ECM object.

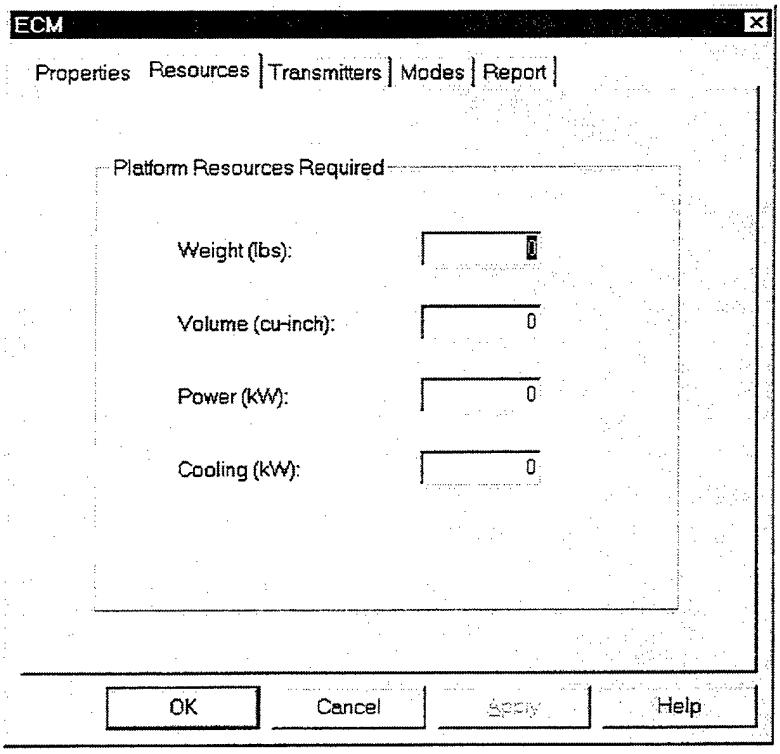

Figure 10-2. Sample of ECM Resources Dialog Page

Duplicate: Creates a copy of the currently selected transmitter. It will be listed with the same name as the copied transmitter plus " (copy)".

1. Editing a Transmitter

With a transmitter selected on the list, double-clicking or selecting **Edit** presents the users with the Transmitter Properties dialog contains several properties to be edited. A sample of ECM Transmitter Properties page is provided in Figure 10-4.

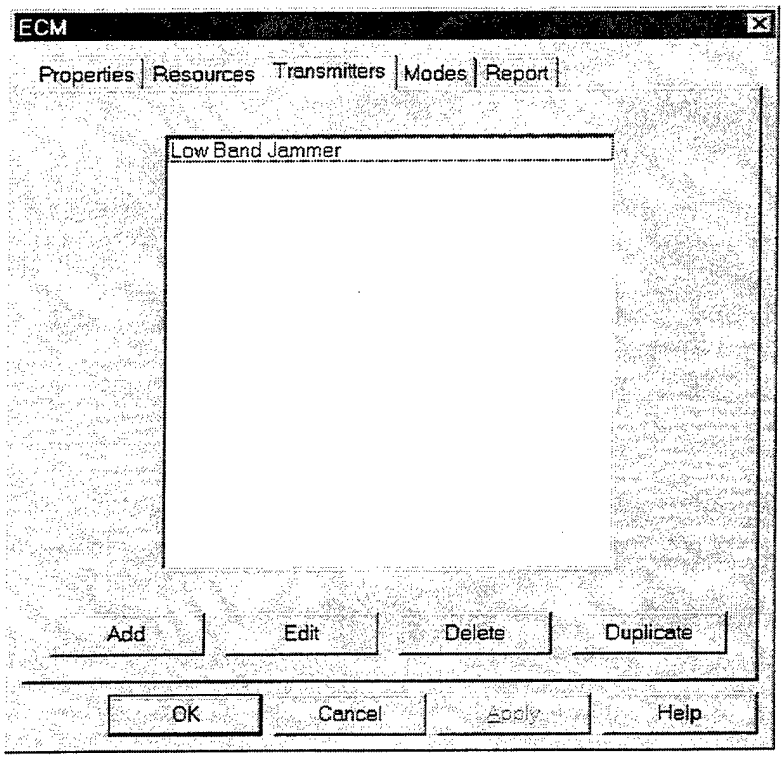

Figure 10-3. Sample of ECM Transmitters Dialog Page

Name: This is a text string identifying the transmitter in lists.

Peak Power: Defines the peak power (in kilowatt) of the transmitter. The ERP will include the antenna gain.

Max # of Spots: Defines the number of frequencies that can be jammed.

Max # of Beams: Defines the number of beams this transmitter can form.

Frequency Coverage: Defines the operating frequency range of this transmitter (in MHz).

Antenna:

- Gain: This is the gain (in dB) associated with this transmitter. If it is not given, this value can be calculated using equation below where θ_a and θ_e are the 3-dB azimuth and elevation beamwidths in radians.

$$G \cong \frac{4\pi}{\theta_a \theta_e} \qquad (10.1)$$

- Azimuth / Elevation Beamwidth: This is the 3-dB azimuth and elevation beamwidths in degrees of this transmitter.

- Azimuth / Elevation Offset: The angular offset is used for describing the mounting of this antenna relative to the local "front". For example, a side-looking radar mounted on the right side of an aircraft would have an azimuth offset of 90 degrees. A rear facing radar would have an azimuth offset of 180 degrees. The angular offset does not describe scan or aiming sector. It is simply an offset relative to the platform on which the antenna is mounted.

- Azimuth / Elevation Coverage: Defines the angular coverage of the transmitter. Emitters outside of the coverage angles cannot be jammed.

- Polarization: Single-click opens a pull-down menu allowing the users to select the polarization associated with this transmitter. Tuning co-pol will result in 0 dB loss. Cross-pol will result in 25 dB loss.

- Array (1/N^2): Selection indicates that jammer is an element of an active arrays that can form multiple beams simultaneously to cover more threat types, but at the cost of an ERP reduction proportion to $1/N^2$, where N is the number of beams.

- Az Beam Stearing: If selected, then the jammer will update the azimuth stearing of the beam to point at the emitters of interest.

- El Beam Stearing: If selected, then the jammer will update the elevation stearing of the beam to point at the emitters of interest.

- Stear Beams in Turns: Selecting this option indicates the beam is able to track the emitters while the aircraft is turning. If the beam does not track in the turns, then emitters will become uncovered when the jammers are turning.

- Apply Cos(Theta): Applies to electronically steared beams of which the gain will degrade with the cosine of the angle from the boresight of the antenna.

- Sidelobes: The users have the option of identifying a particular antenna pattern to associate with this transmitter, or the users can choose to have no pattern. The patterns available to users are those that were created under the Signatures tab. For this reason, the users should create the signatures before create the systems. If the users chooses no sidelobes, ARES uses 0 dBi (isotropic) to represent all values outside of the mainbeam.

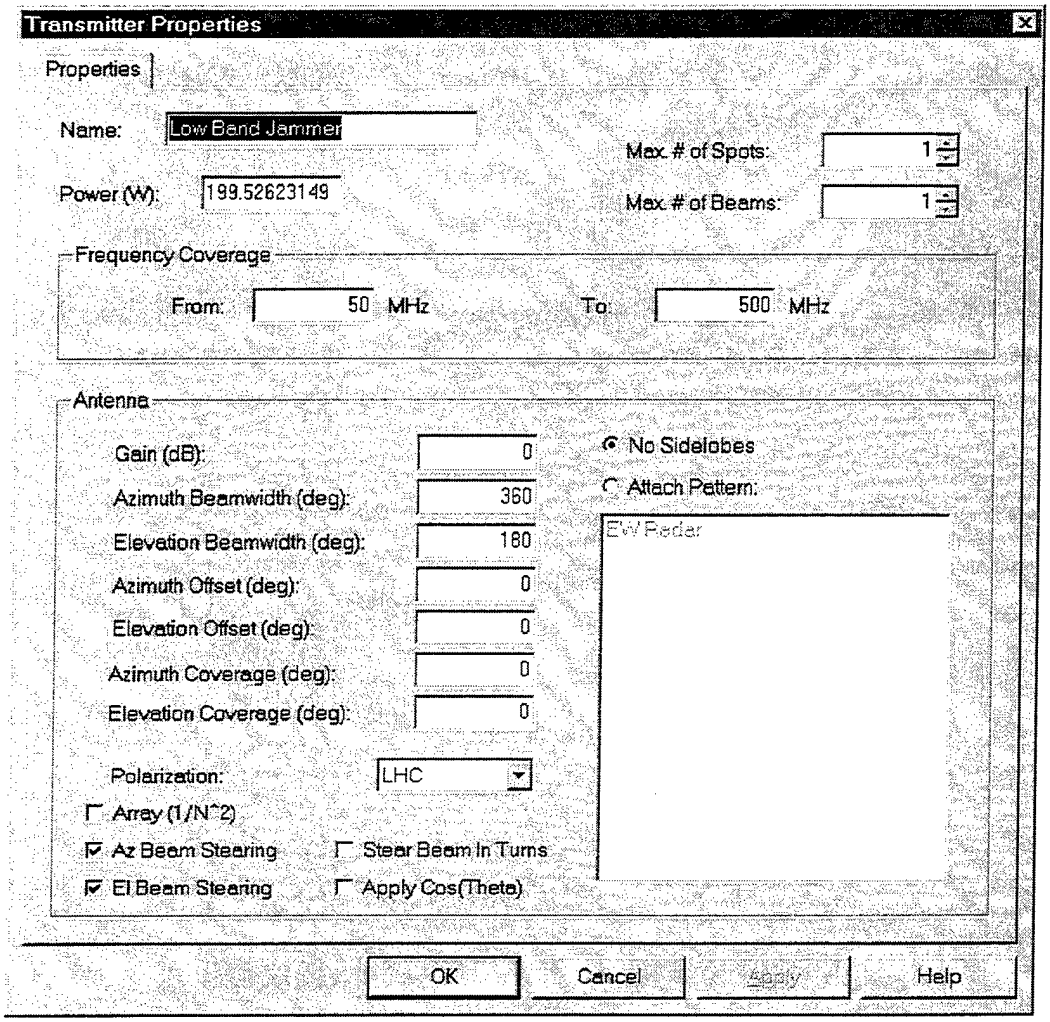

Figure 10-4. Sample of ECM Transmitter Properties Dialog Page

D. MODES

The ECM Modes page, as shown in Figure 10-5, contains a list of all modes associated with this ECM system. Below this list are four buttons described below.

Add: Adds a new, but blank mode object to the ECM. It will be shown in the list as "New Mode" and will immediately be opened for editing.

Edit: Opens the currently selected mode for editing. Alternatively, double-clicking the mode in the list also opens the antenna.

Delete: Permanently deletes the currently selected mode from the ECM object.

Duplicate: Creates a copy of the currently selected mode. It will be listed with the same name as the copied mode plus " (copy)".

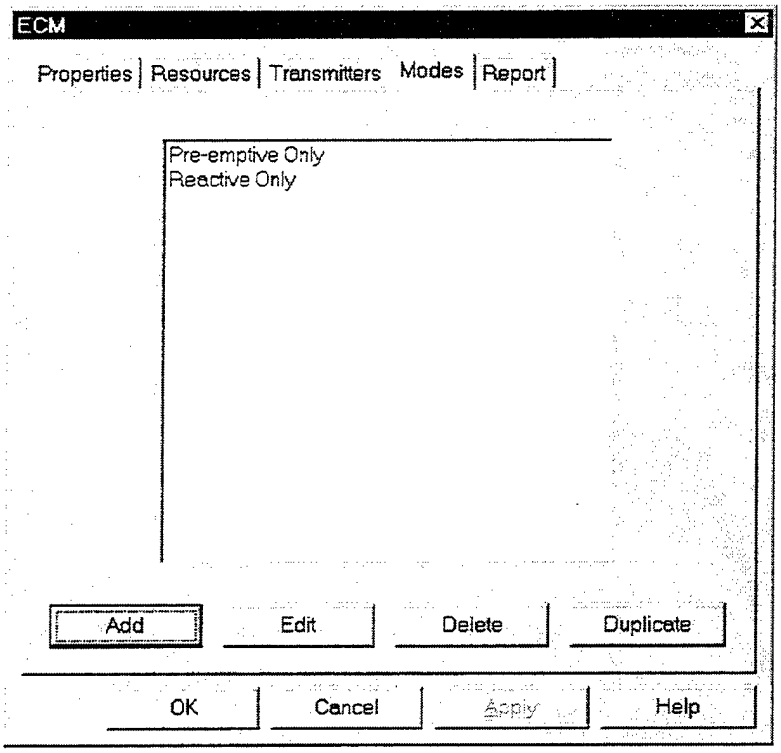

Figure 10-5. Sample of ECM Modes Dialog Page

1. Editing a Mode

With a mode selected on the list, double-clicking or selecting **Edit** presents the users with the ECM Mode Properties dialog containing three pages as depicted in Figure 10-6. Description of each page is as follows.

a. Properties

The ECM Mode Properties page, shown in Figure 10-6, contains only a single entry for the users to specify the name of the mode.

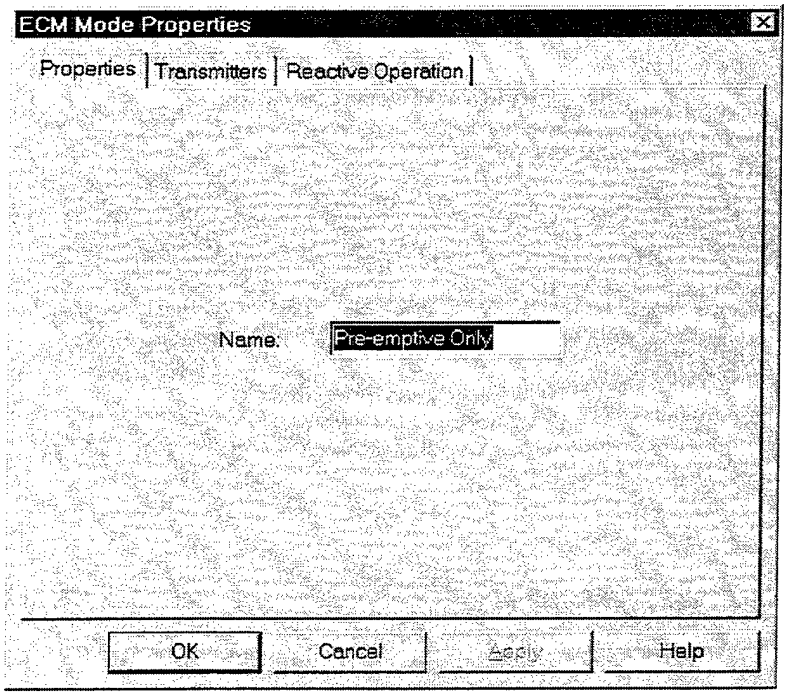

Figure 10-6. Sample of ECM Mode Properties Dialog Page

b. Transmitters

The ECM Mode Transmitters, as similarly shown in Figure 10-7, presents a list of all transmitters created on the ECM Transmitters page of which the users can select for appointing preemptive assignment (i.e. standoff jamming assignment). With a transmitter selected on the list, double-clicking presents the users with the Assignment Schedule dialog, as appeared in Figure 10-8, which contains four properties to be defined as described below.

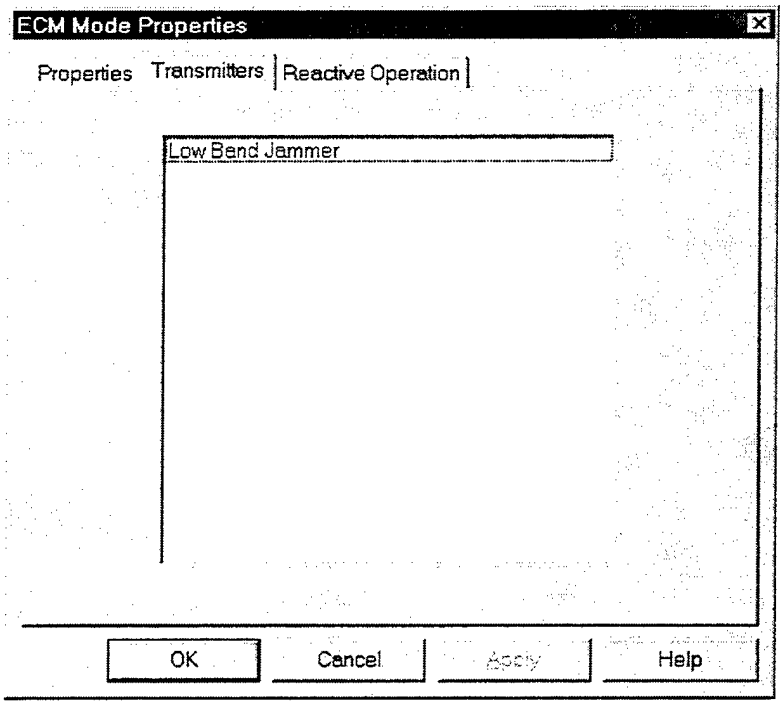

Figure 10-7. Sample of ECM Mode Transmitters Dialog Page

Aimpoint: Defines the aimpoint of the jammer in latitude and longitude.

Low / High Frequency: Defines the jamming frequency coverage of the transmitter.

Duty Cycle: Select the radio button indicating the duty cycle of this transmitter, which in turn is used to determine whether coherent sidelobe cancellers will impact this jammer.

Technique Gain: Button, when depressed, opens a dialog, shown in Figure 10-9, consist of two columns described as followed:

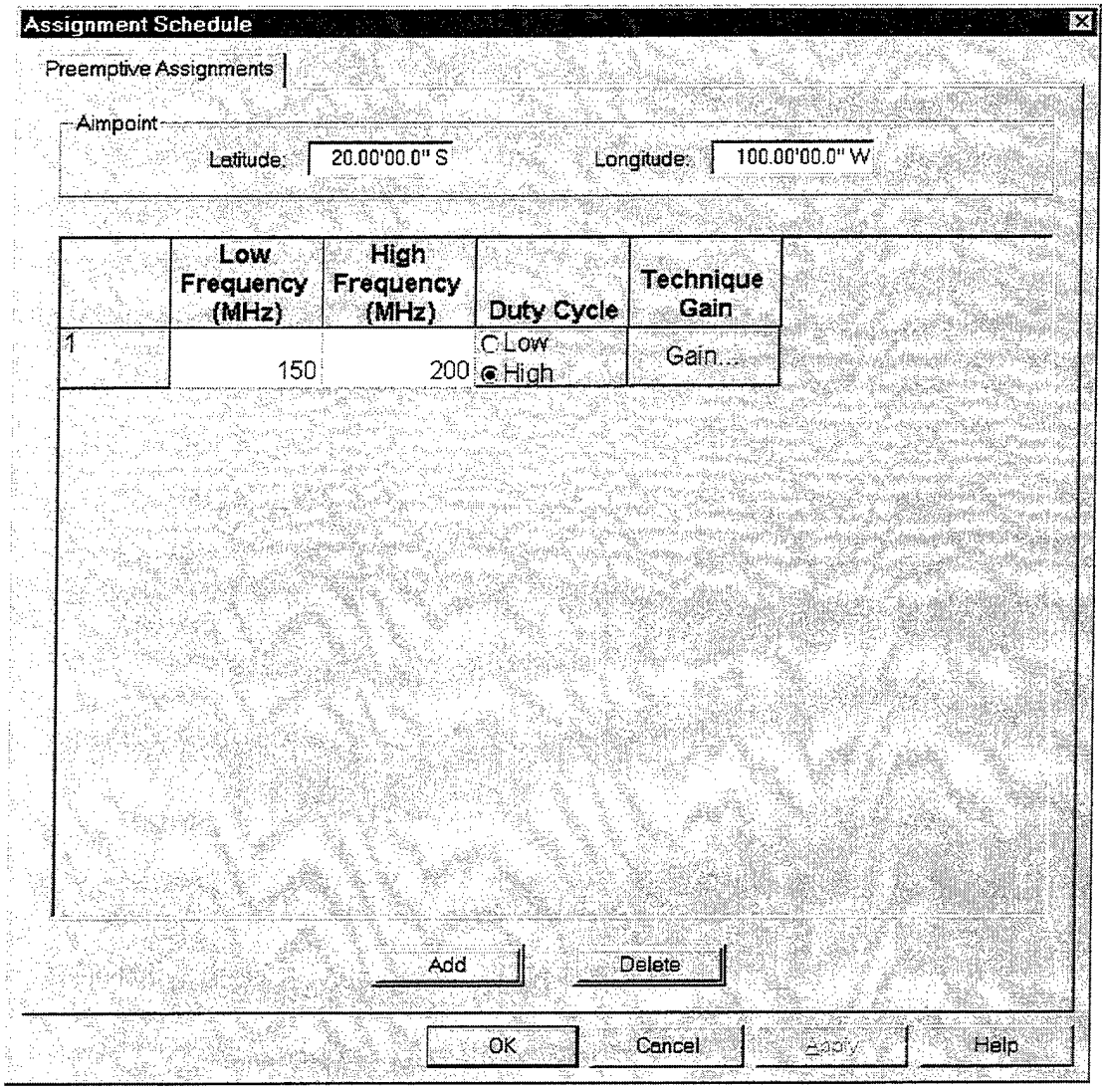

Figure 10-8. Sample of ECM Transmitters Assignment Schedule Dialog Page

Radar: Contains a list of radar systems created under Systems tab of which the operating frequency is within the selected transmitter frequency coverage.

Technique Gain: Defines the amount of the modulation gain to be added to straight noise gain for jamming against a particular radar.

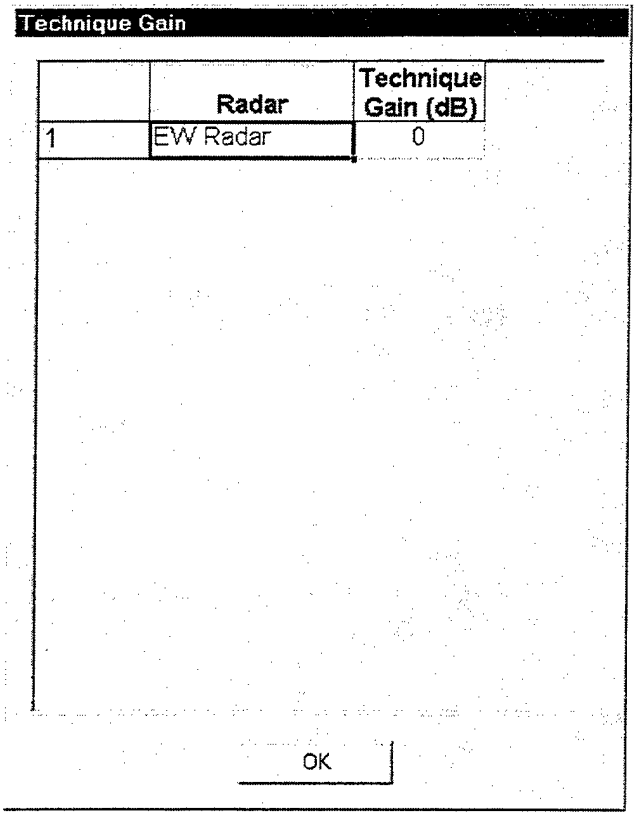

Figure 10-9. Sample of ECM Technique Gain Dialog Page

c. Reactive Operation

The ECM Reactive Operation page, as shown in Figure 10-10, is where the users can appoint and coordinate reactive assignment. It contains four fundamental blocks of information as described in detail below.

(1) Information Sources. This is a table listing all the sources that the jammer could potentially use to make a jamming decision.

Source: A listing of all possible ESM systems (as defined under the ESMs folder).

Accept?: Determines how information from this source will be treated.

- Required: Signifies jammer cannot jam until this source has reported.
- Okay: Signifies jammer will use information from this source to make jamming assignments.
- Ignored: Signifies this source is of no consequence and can be disregarded.

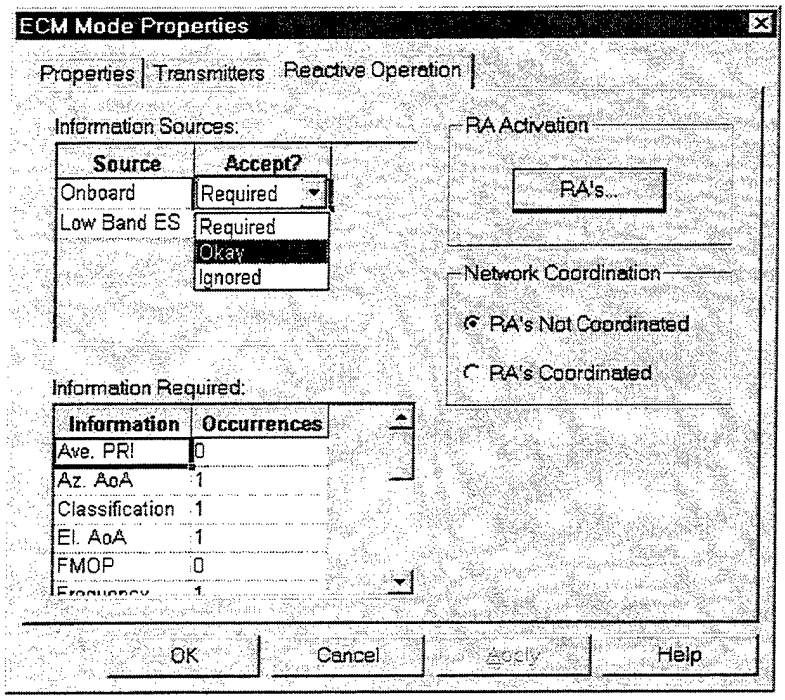

Figure 10-10. Sample of ECM Reactive Operation Dialog Page

(2) Information Required. This is a table listing all the parameters that the jammer could potentially use to make a jamming decision. Inherently jammer will not jam until it have received the number of reports of each parameter indicated by the users. For example, if Classification = 1, Frequency = 1, and Az. AoA = 2, then the jammer cannot do anything until it has heard classification from at least one source, frequency from one source, and azimuth angle of arrival from at least two sources.

(3) Network Coordination. Select the radio button indicating whether the reactive assignment is coordinated by the network for this transmitter. If

Network coordination is selected, then the jammer will factor the decisions of other jammers into its decision.

(4) RA Activation. Button, when depressed, opens a dialog, shown in Figure 10-11, consisting of 11 property columns to be edited. These are described as followed:

Radar: This column lists all radars created under Systems tab of which the operating frequency is within the selected ECM transmitter frequency coverage.

RA Activate: Select the radio button indicating whether the users want this reactive jamming assignment to be active or inactive for this radar.

Technique: Select the radio button indicating how gain is determined by the jammer.

- Noise: If selected, then the quality of the jamming above noise is determined by the Technique Gain column.
- Coherent: Signifies the jammer techique gain will be equivalent to the radar's processing gain.

Strategy: Select the radio button indicating how old jamming spots will be treated by jammer.

- Following: Signifies the jammer will "age out" old jamming spots.
- Trailing: Signifies the jammer will leave old spots in place (no age out).

Noise Technique Gain: Defines the amount of the modulation gain above straight noise for jamming against a particular radar.

Spot Size: Defines the bandwidth of the noise.

Duty Cycle: Select the radio button indicating the duty cycle for this transmitter mode, which in turn is used strictly to determine whether sidelobe cancellers are effective.

Test Geo-Eligibility: Single-click on the cell opens a pull-down menu of selection as described below.

- False: The jammer responds regardless of where the emitter is.
- Rel. to Ownship: The jammer responds only to emitters that are within the given range radius to the jammer. This radius is given by the range field.
- Rel. to Lat/Long: The jammer responds only to emitters that are within the given range radius to a point on the ground as given by the latitude and longitude fields.

Range: Defines the range radius at which only emitters within this range is jammed.

Latitude: Defines the latitude of a point on the ground at which only the emitters within the given range radius of this point are jammed.

Longitude: Defines the longitude of a point on the ground at which only emitters within the given range radius of this point are jammed.

E. REPORT

The Publish page, depicted in Figure 10-12, contains a list of information that can be transmitted by this ECM system over a network. If the **Publish** radio button is selected, then players using this ECM system will offer the selected information to any networks of which it is a member (see Chapter XII). The information offered is described below.

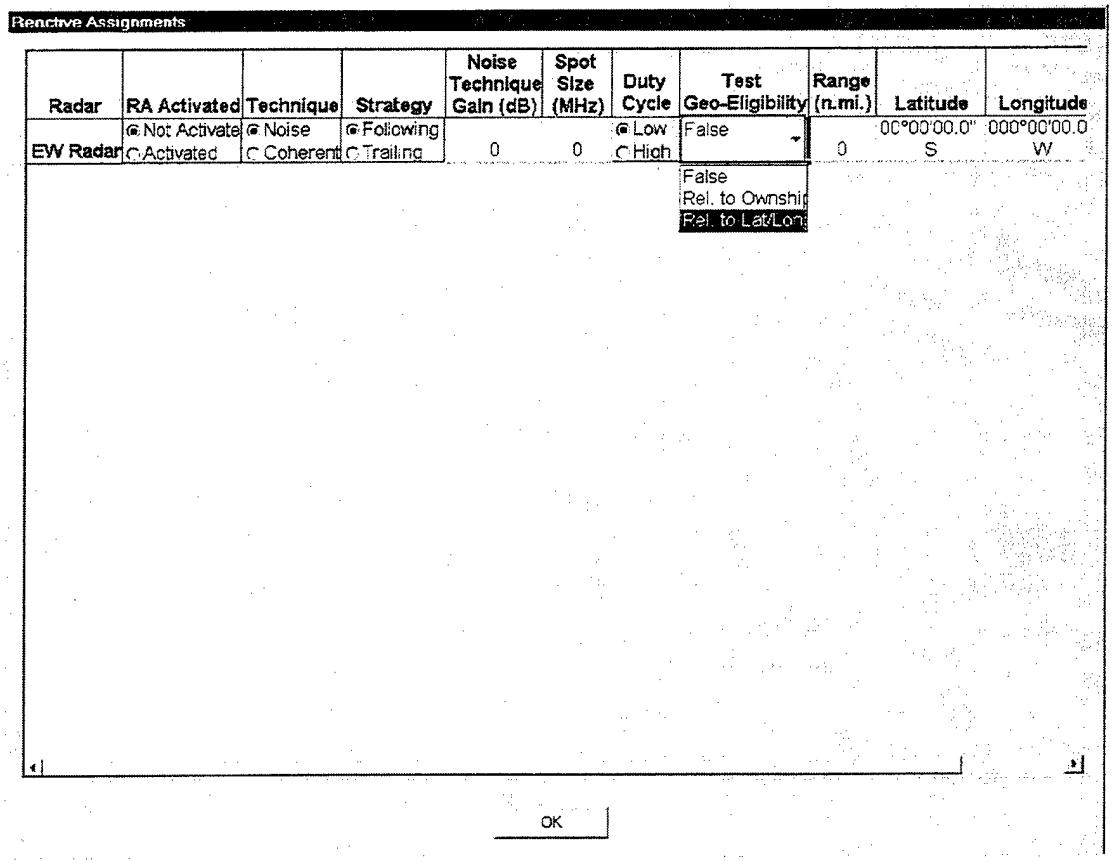

Figure 10-11. Sample of ECM Reactive Assignment Schedule Dialog Page

Player ID: This is an 8 bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

System Type: This is a 4-bit parameter identify the type of the player to the network.

Player Position: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying player's current position.

Transmit Time: This is a single word that identifies the time at which the packet was created. Select this if the users want each packet to have a time-stamp indicating the age-of-the information to its recipients.

Track Number: This is a 16 bit parameter representing the locally assigned track number.

Engaged/Disengaged: This is a 1-bit parameter identify if the track is engaged or disengaged.

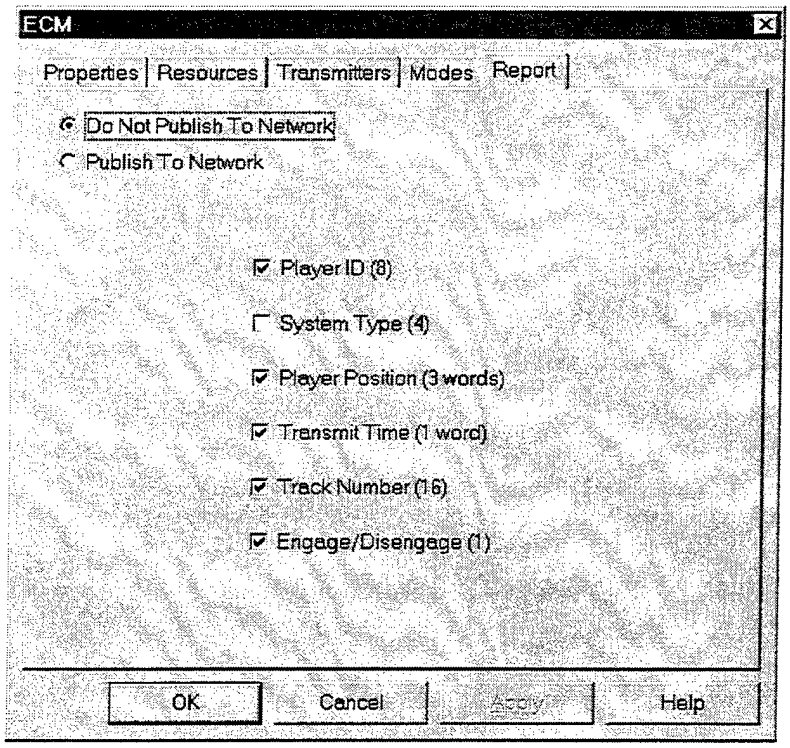

Figure 10-12. Sample of ECM Publish Dialog Page

XI. TEMPLATES TAB COMMANDS

The "Templates" tab of the Scenario Workbook displays all models available to create players in the scenario. The models are listed in alphabetical order by system type. A sample of the Templates Tab hierarchy is shown in Figure 11-1.

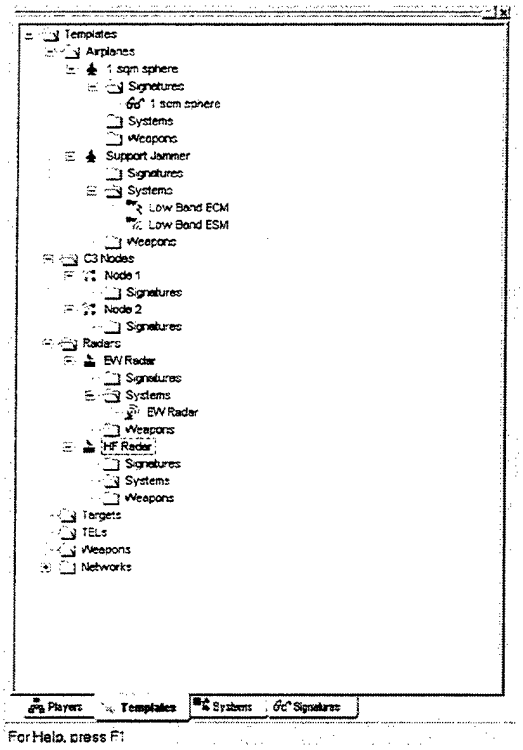

Figure 11-1. Sample of Templates Tab Hierarchy

A. TREE OPERATIONS

The tree presented in the Templates tab supports several basic operations. These are described as follows:

1. Right-Clicking a Model Folder

Right-clicking a model folder presents the users with a context-sensitive menu as shown in Figure 11-2. The operation of interest is **Add** which creates a new template

object of the select model type. The new object initially has no components (e.g., systems, signatures, weapons, etc.) and must be edited prior to use.

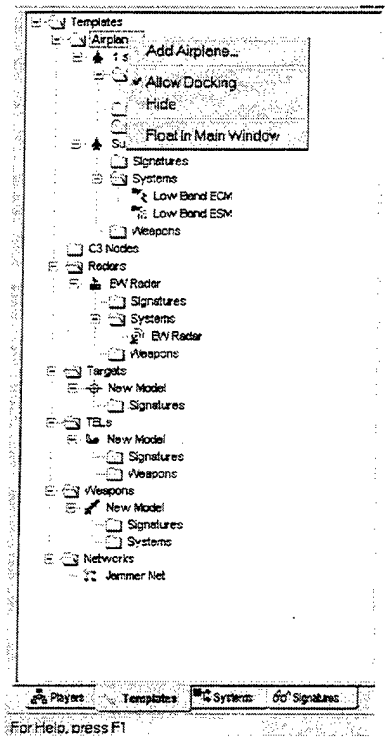

Figure 11-2. Model Folder Pop-Up Menu

2. Right-Clicking a Model

Right-clicking on an object in any folder presents the users with a context-sensitive menu as shown in Figure 11-3. There are three operations of interest. These are **Open**, **Delete**, **Duplicate**, and **GA Constraint.**

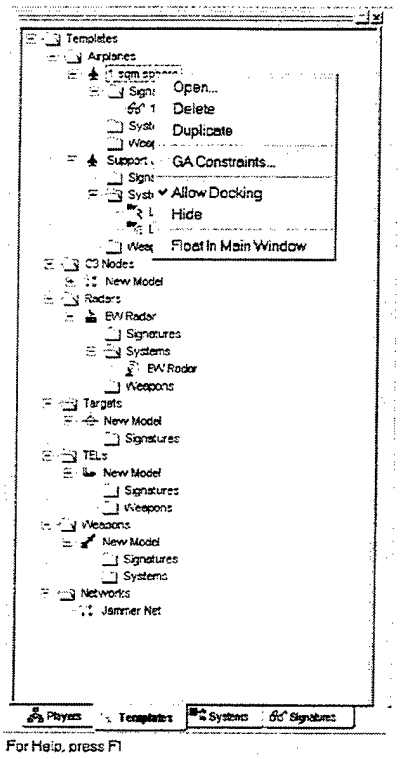

Figure 11-3. Model Pop-Up Menu

Open: Opens the model for editing. Detailed descriptions on editing each individual model are provided in the subsequent sections.

Delete: Permanently removes the selected model from the scenario.

Duplicate: Replicates the selected model onto the tree structure. The new system appears in the tree with the old name plus " (copy)".

GA Constraint: This is an optional advanced feature in ARES and can be omitted by the users. In general, selecting this option invokes a dialog as shown in Figure 11-4 allowing the users to specify the resources available on the chosen platform in term of size, weight, and support requirements. If the Constraint Platform Resources field is checked, ARES will consider these parameters as the maximum values allowed

for the platform in GA system selection process. If the GA develops a solution where the systems require more resources (the sum of their required resources) than the allowed maximum values for the platform, then the GA will simply "turn off" that platform (i.e., not use it).

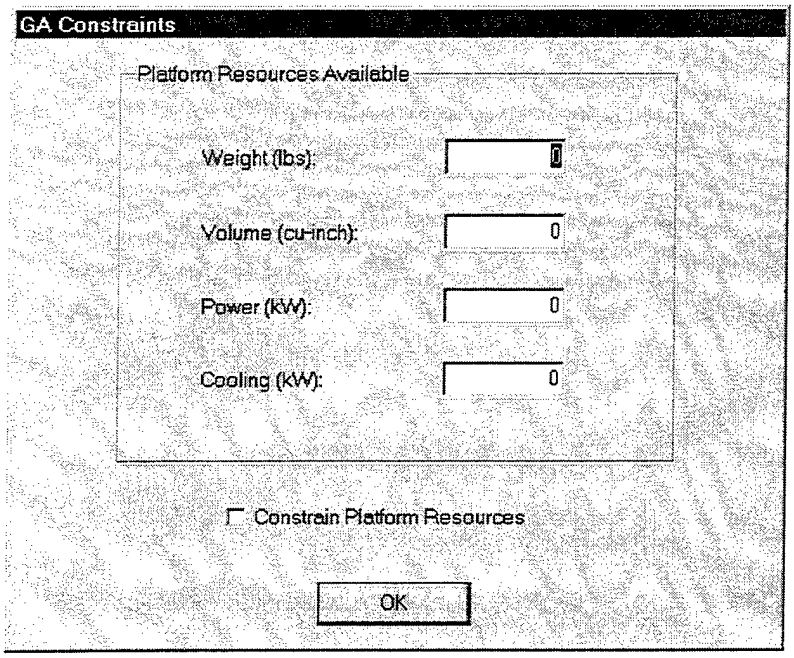

Figure 11-4. GA Constraints Dialog

3. Right-Clicking a Component Folder

Right-clicking a component folder presents the users with a context-sensitive menu as shown in Figure 11-5. The operation of interest is **Attach** which opens a dialog allowing the users to select the appropriate component systems belonging to the model. Any model may be assigned an unlimited number of systems.

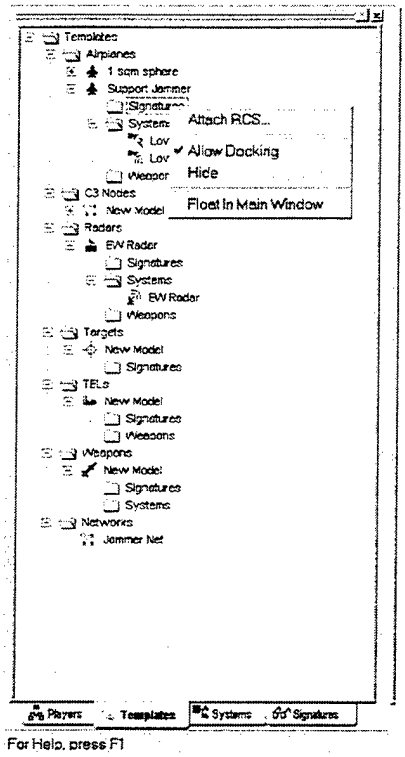

Figure 11-5. Component Folder Pop-Up Menu

4. Right-Clicking a Component Folder

Right-clicking a component presents the users with a context-sensitive menu as shown in Figure 11-6. The three operations of interest are **GA Selection, No GA Selection, and Detach System.**

GA Selection: Opens a dialog allowing the users to identify all of the alternate systems that could populate that location on the model for GA optimization process. When a component is flagged for GA selection, the model name is changed to red.

No GA Selection: Deselects the system for GA selection.

Detach System: Permanently removes the selected component from the model.

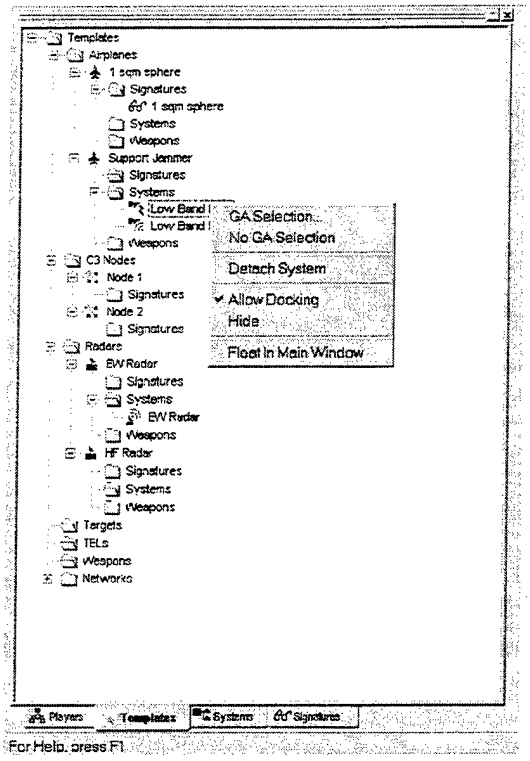

Figure 11-6. Component Pop-Up Menu

B. EDITING AN AIRPLANE MODEL

An airplane model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open.** In either case, the users are presented with a dialog that appears as in Figure 11-7 which contains only a single entry for the users to specify the name that is used to identify the model throughout ARES. It is displayed under Radars folder on the Templates tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for the model.

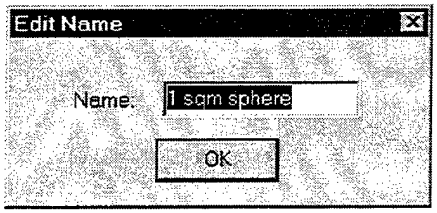

Figure 11-7. Model Edit Name Dialog

C. EDITING A C3 NODE MODEL

A C3 Node model in the Templates tab represents an integrated air defense system (IADS) network model and may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open.** In either case, the users are presented with a dialog that appears as in Figure 11-8 which contains five properties to be defined as described below.

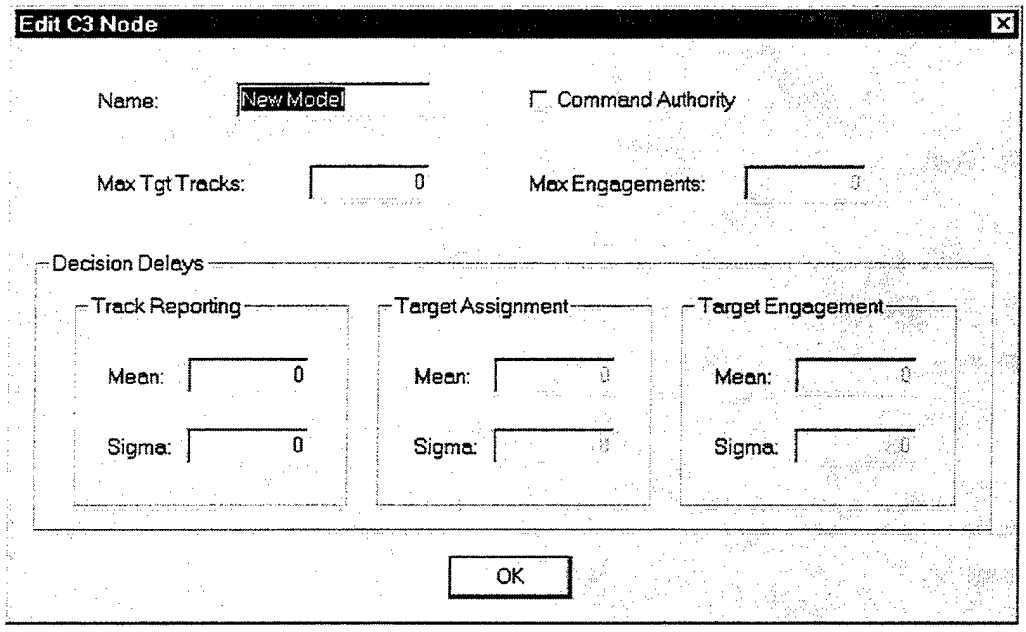

Figure 11-8. Edit C3 Node Dialog

Name: This is a text string that is used to identify the C3 Node throughout ARES. It is displayed under C3 Node folder on the Templates tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for the model.

Command Authority: If selected, then this C3 node will make decisions to engage weapons.

Max Tgt Track: This is the maximum number of targets that this C3 node can track at one time.

Max Engagement: This is the maximum number of target engagements that the C3 node can manage simultaneously.

Decision Delay:

- Track Reporting: This is a delay (in seconds) that will be applied at this node when forwarding track reports to other players.
- Target Assignment: This is the delay (in seconds) that will be applied at this node when assigning targets to other players (requires command authority).
- Target Engagement: This is the delay (in seconds) that will be applied at this node when giving target engagement commands (requires command authority).

D. EDITING A RADAR MODEL

A radar model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 11-7 which contains only a single entry for the users to specify the name that is used to identify the model throughout ARES. It is displayed under Radars folder on the Templates tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for the model.

E. EDITING A TARGET MODEL

A target model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 11-7 which contains only a single entry for the users to specify the name that is used to identify the model throughout

ARES. It is displayed under Targets folder on the Templates tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for the model.

F. EDITING A TEL MODEL

A Transporter Erector Launcher (TEL) model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 11-7 which contains only a single entry for the users to specify the name that is used to identify the model throughout ARES. It is displayed under TELs folder on the Templates tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for the model.

G. EDITING A WEAPON MODEL

A weapon model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 11-9 which contains four properties to be defined as described below.

Name: This is a text string that is used to identify the weapon throughout ARES. It is displayed under Weapons folder on the Templates tab, and will be used in other lists as well. It is imperative that the users define a concise, but descriptive name for the model.

Home-on-Jam: If selected, then this weapon can home on jammers within its lethal envelope if that jammer is jamming the target tracking radar for this missile.

Weapon Type: Select the radio button indicating the class of this weapon.

Parameters:

- Min / Max Range: Defines the minimum and maximum lethal ranges of the weapon in nautical mile.
- Min / Max Altitude: Defines the minimum and maximum altitudes of the targets that can be engaged by this weapon.

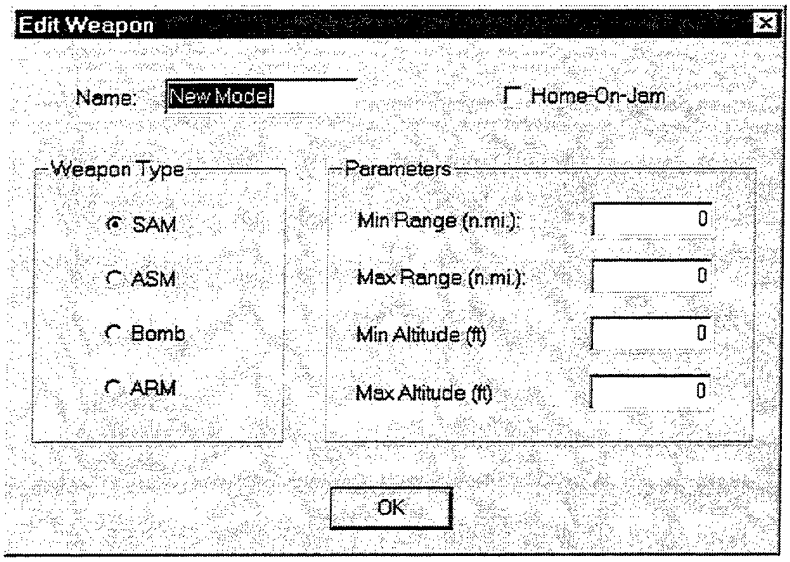

Figure 11-9. Edit Weapon Dialog

H. EDITING A NETWORK MODEL

A network model in the Templates tab may be opened for editing by either double-clicking the object or by right-clicking and selecting **Open**. In either case, the users are presented with a dialog that appears as in Figure 11-10 which contains three properties to be defined as described below.

Name: This is a text string that is used to identify the network throughout ARES. It is displayed under Networks folder on the Templates tab, and will be used in other lists

as well. It is imperative that the users define a concise, but descriptive name for the model.

Color: Opens a dialog allowing the users to select the line color corresponds to the network connecting players on the map in Edit view window.

Wire / Wireless: Select the radio button representing the connection type of this network. Wired networks do not perform line-of-sight or range checks, while wireless networks will employ line-of-sight and range checks.

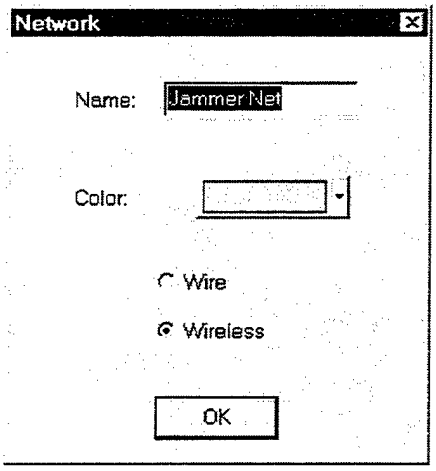

Figure 11-10. Network Dialog

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XII. PLAYERS TAB COMMANDS

The "Players" tab of the Scenario Workbook displays all instantiated objects in the scenario in a hierarchical tree format. The tree presentation may be used to represent a command and control hierarchy. If importing an MSFD file, the tree will be created for the users automatically using the Unit Subordination Codes embedded in the MSFD file. The Players tab supports standard cut, copy, paste, and delete functions. These commands operate on all selected (highlighted in yellow) objects and may be accessed via the Edit drop-down menu and File toolbar menu.

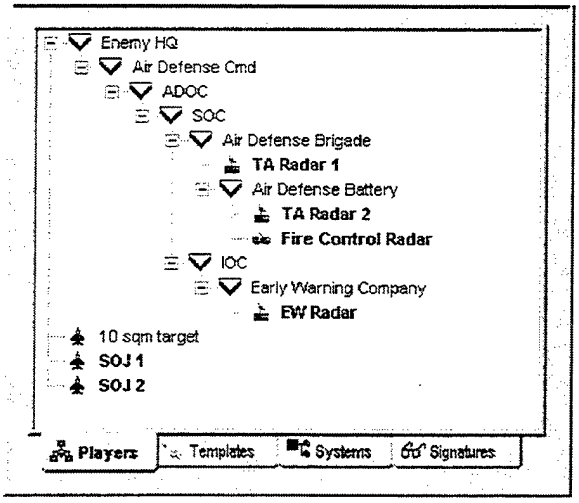

Figure 12-1. Sample of Players Tab Hierarchy

A. TREE OPERATIONS

The tree presented in the Players tab supports several basic operations. These are described as follows:

1. Right-Clicking Open Area

Right-clicking the open area of the Players window presents the users with a context-sensitive menu as shown in Figure 12-2. The operation of interest is **Add Player** which displays a pop-up menu as shown in Figure 3-14 for creating a new, neutral object

of selected type at the geographic center of the scenario to the top level of the tree structure. Choosing any item from this menu presents a dialog box listing available models of the chosen type for selection. These models must have been previously created on the Templates tab of the Scenario Workbook. Alternatively, this command may be accessed via the Scenario drop-down menu and Scenario toolbar menu.

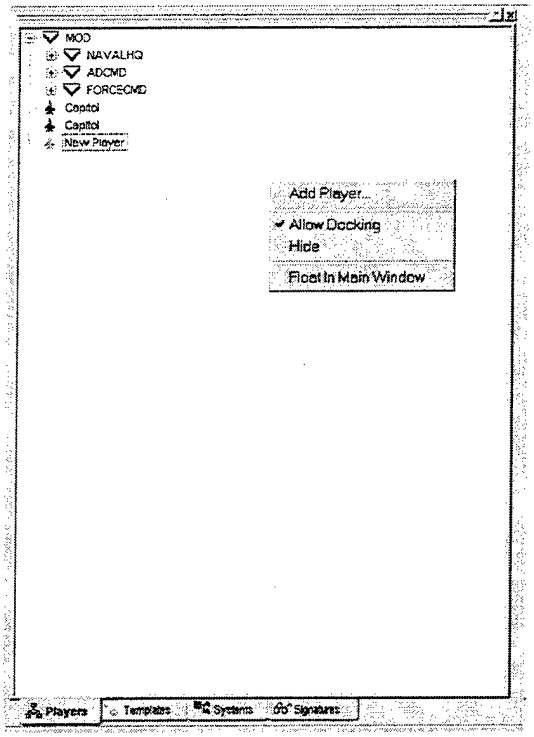

Figure 12-2. Empty Space Pop-Up Menu

2. Right-Clicking Player

Right-clicking a player of "static" type presents the users with a context-sensitive menu as shown in Figure 12-3. There are 12 operations of interest as described below.

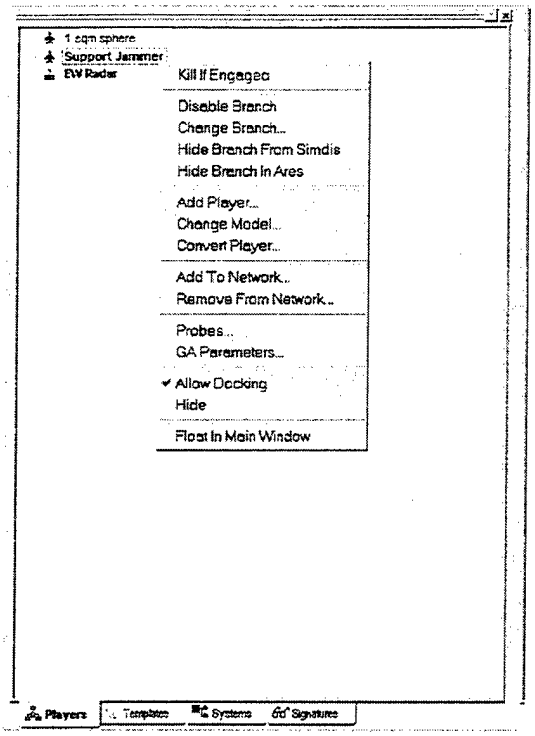

Figure 12-3. Player Pop-Up Menu

a. Kill if Engaged

This command is displayed only when the players is not of "static" type. This is a form of kill removal. If this is selected, then this player will stop playing (i.e., be killed) if it is ever engaged by a weapon.

b. Enable / Disable Branch

This command allows the users to select whether a player will participate in a scenario. This option was put in so that the users could have one large scenario, then simply disable the players that are not relevant for a particular run. When a player is disabled, it will appear in a darker color on the map.

c. Change Branch

This command invokes the dialog as shown in Figure 12-4 and applies the selected command globally to all players that are members of the branch.

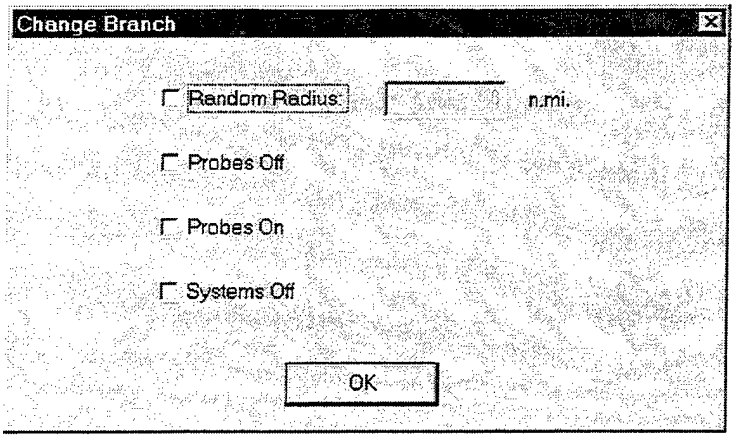

Figure 12-4. Change Branch Dialog

d. Hide Branch From SIMDIS

If selected, this player will not appear in any SIMDIS graphics [Ref. 3].

e. Hide Branch in ARES

If selected, this player will not appear in ARES map view (a sort of "declutter" button).

f. Add Player

Selecting this command displays a pop-up menu as shown in Figure 3-14 for creating a new, neutral object of selected type at the geographic center of the scenario to the next lower level of the tree structure. Choosing any item from this menu presents a dialog box listing available models of the chosen type for selection. These models must have been previously created on the Templates tab of the Scenario Workbook. Alternatively, this commands may be accessed via either the Scenario drop-down menu or the Scenario toolbar menu.

g. Change Model

Selecting this command displays a dialog box listing available models of the chosen type for selection.

h. Convert Player

Selecting this command displays the player type dialog as shown in Figure 3-15 allowing the users to convert the selected object from one type to another. Alternatively, this commands may be accessed via either the Scenario drop-down menu or the Scenario toolbar menu.

i. Add to Network

This command is displayed only when the players is not of "static" type and presents a dialog box listing available network for selection. These networks must have been previously created on the Templates tab of the Scenario Workbook. A player can participate on an unlimited number of networks.

j. Remove from Network

This command is displayed only when the players is not of "static" type. Selecting this option presents a dialog box listing available networks of which the player is a member for participation removal.

k. GA Parameters

Selecting this command invokes the Genetic Algorithm dialog which features two pages, **GA Parameters and GA Constraints**, containing properties to be defined for GA simulation. This command is displayed only if the player is not "static" type and is identified as belonging to the friendly force in the player's Identification property page described in Section B. When a player is flagged for GA selection, its name is displayed in red.

GA Parameters: As shown in Figure 12-5, this page contains two block of information described below.

(1) Search Space: Allows players to define the search space that GA optimization is based on.

- Existence: If checked, then the GA will determine whether this player exists or not (i.e., whether it is needed).
- Altitude: If checked, then the GA will select the appropriate operating altitude for the player.
- Latitude and Longitude: If selected, then the GA will select the appropriate operating latitude and longitude for the player.
- Model: If selected, then the GA will select which type of model this player is.

(2) Cost: Defines the relative cost of the player. This feature is obsolete and can be ignored.

GA Constraints: This page, shown in Figure 12-6, consists of three properties to be edited as followed:

- Minimum: This is the lower bound of the search space for this parameter
- Maximum: This is the upper bound of the search space for this parameter
- Increment: If the search space is discrete, then this is a positive number defining the size of the "grid". If the users want a continuous search space, then enter 0.

l. Probes

This command is displayed only when the players is not of "static" type and presents a dialog allowing the users to select parameters of interest for post-processing analysis. In general, the dialog is a combination of several pages: the **Player** page, individual page for each system associated with player's model, and the **Network** page if the player is participated on the network. Description of each page is detailed as followed. When a probe is set, the selected player's name is displayed in bold letter.

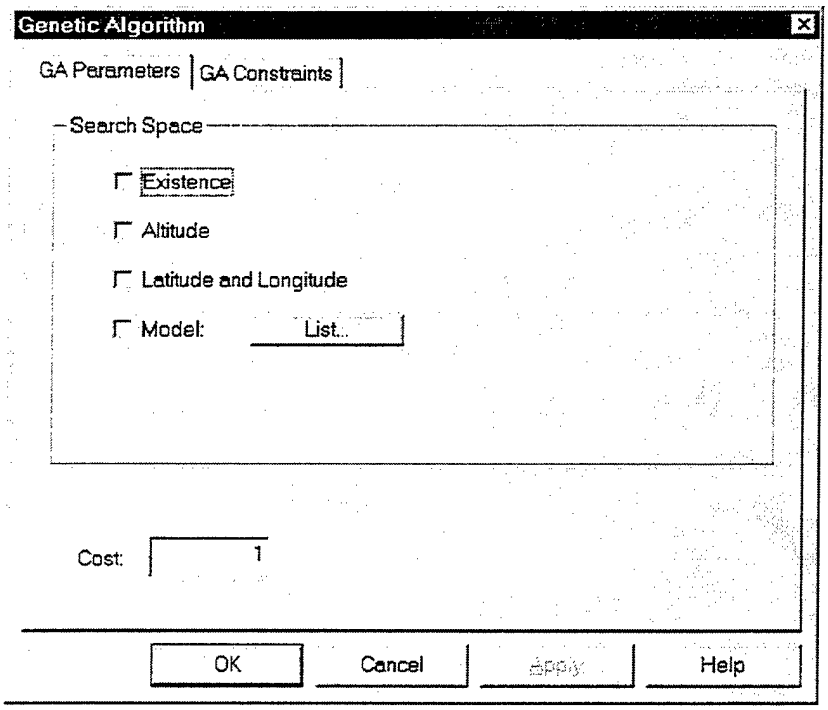

Figure 12-5. GA Parameters Dialog

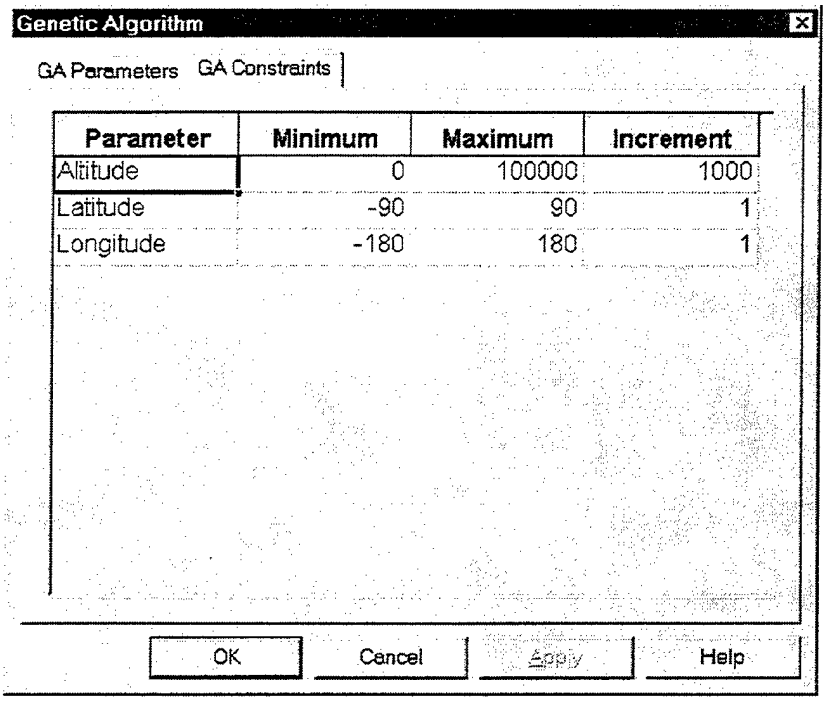

Figure 12-6. GA Constraints Dialog

The **Player** page, as shown in Figure 12-7, contains two fundamental blocks of information as described in detail below.

(1) Scalar. Scalar probes are written in iteration/value pairs.

- Number of Targets Engaged: Outputs the number of targets engaged for the current iteration for this player.

(2) Vector. Vector probes are written in time/value pairs.

- Target Assignment: Outputs information concerning targets assigned for this player.
- Target Engagement: Outputs information concerning targets engaged for this player.

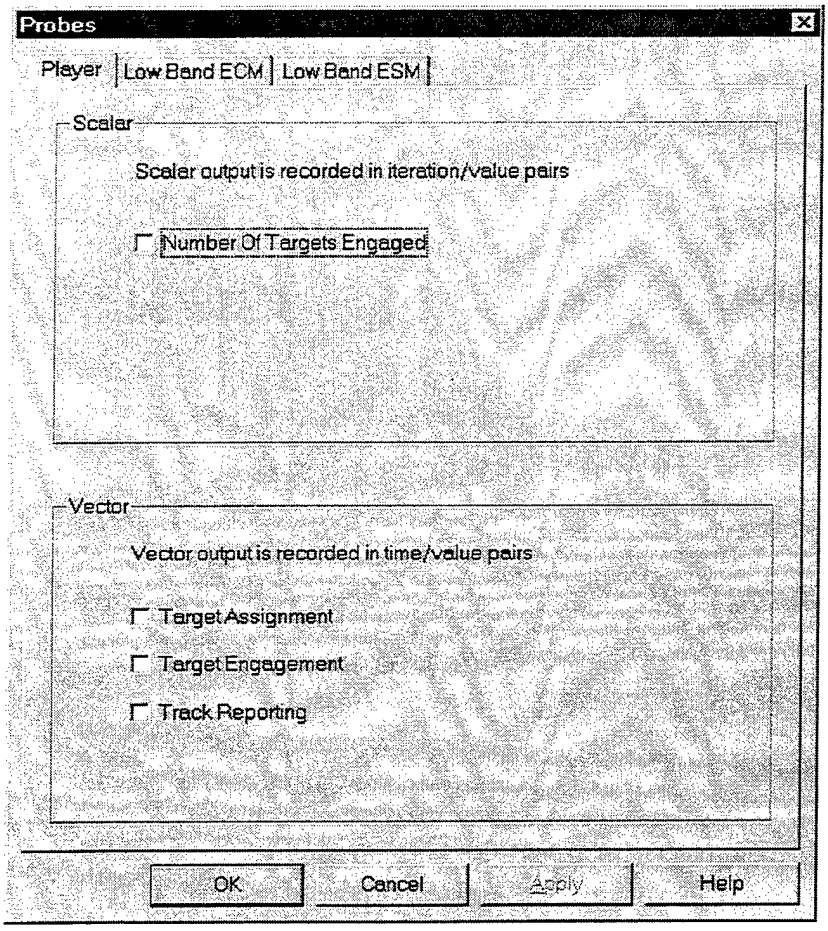

Figure 12-7. Player Probe Dialog

The **ECM** page, as shown in Figure 12-8, contains two fundamental blocks of information as described in detail below.

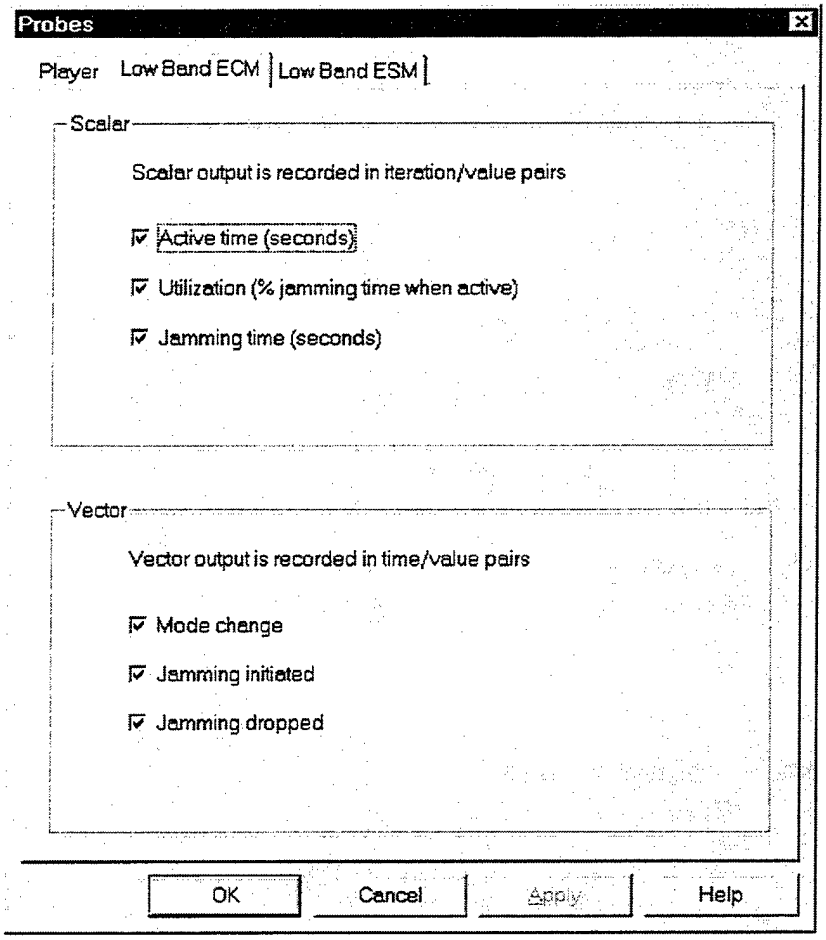

Figure 12-8. ECM Probe Dialog

(1) Scalar. Selecting any option in this block creates an output file labeled "S_*.txt" containing the identified post-processing output for the select player.

- Active Time: Outputs the total on time of the jammer associated with the selected player.
- Utilization: Outputs the percentage of time the jammer associated with the selected player is actively jamming.
- Jamming Time: Outputs the total jamming time of the jammer associated with the selected player.

(2) Vector. Selecting any option in this block creates an output file labeled "V_*.txt" containing the identified post-processing output for the select player.

- Mode Change: Outputs the time instances when a ECM mode change occurred.
- Jamming Initiated: Outputs the time instances when jamming is initiated against a particular radar.
- Jamming Dropped: Outputs the time instances when jamming is dropped against a particular radar.

The **ESM** page, as shown in Figure 12-9, contains two fundamental blocks of information as described in detail below.

(1) Scalar. Selecting any option in this block creates an output file labeled "S_*.txt" containing the identified post-processing output for the select player.

- Active Time: Outputs the total on time of the ESM associated with the selected player.
- Utilization: Outputs the computed percentage of time the ESM is sampling the environment.
- Tracking Time: Outputs the total time the ESM associated with the selected player is actively tracking.

(2) Vector. Selecting any option in this block creates an output file labeled "V_*.txt" containing the identified post-processing output for the select player.

- Mode Change: Outputs the time instances when a ESM mode change is detected.
- Tracking Initiated: Outputs the time instances when tracking is initiated against a particular radar.
- Tracking Dropped: Outputs the time instances when tracking is dropped against a particular radar.
- Acquired / Lose LOS: Outputs the time instances when LOS is acquired or dropped against a particular radar.

- Pulse Density: Outputs the pulse density processed by the ESM system associated with the selected player at any time instances.

- Signal Density: Outputs the signal density detected by the ESM system associated with the selected player at any time instances.

- Pulse Descriptor Word: Selecting this option creates an output file labeled "P_*.txt" containing pulse train data. Be careful when requesting pulse descriptor words (PDW's) since it is easy to flood the data disk. Consider requesting PDW "snapshots" by use of vector start and vector end.

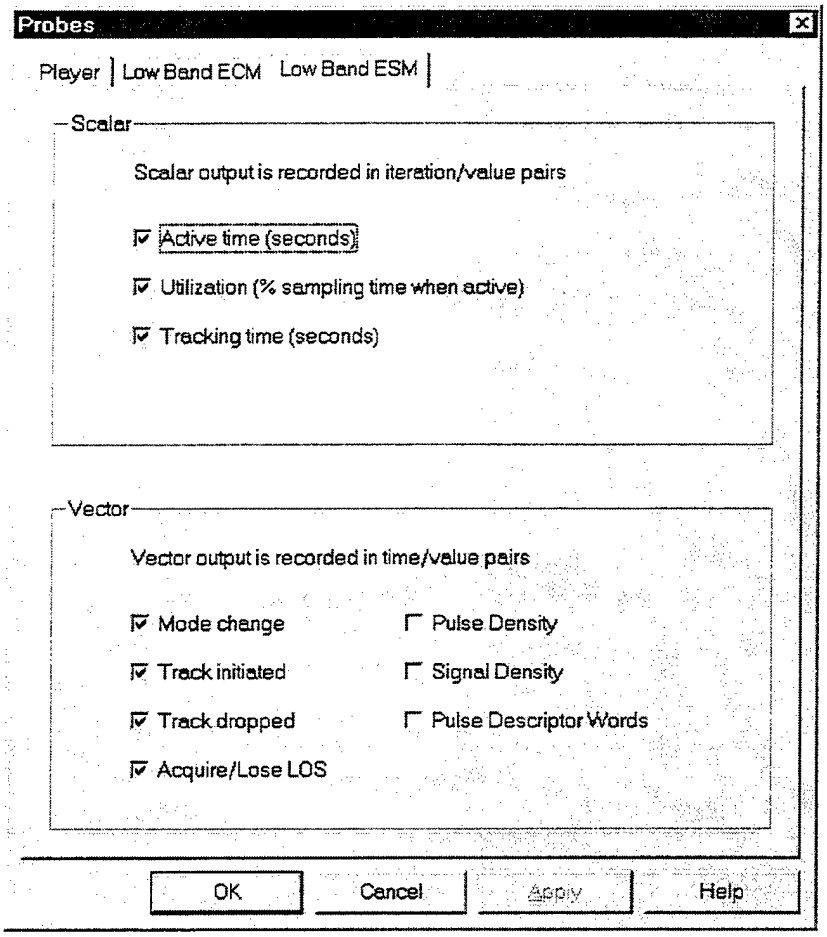

Figure 12-9. ESM Probe Dialog

The **Radar** page, as shown in Figure 12-10, contains two fundamental blocks of information as described in detail below.

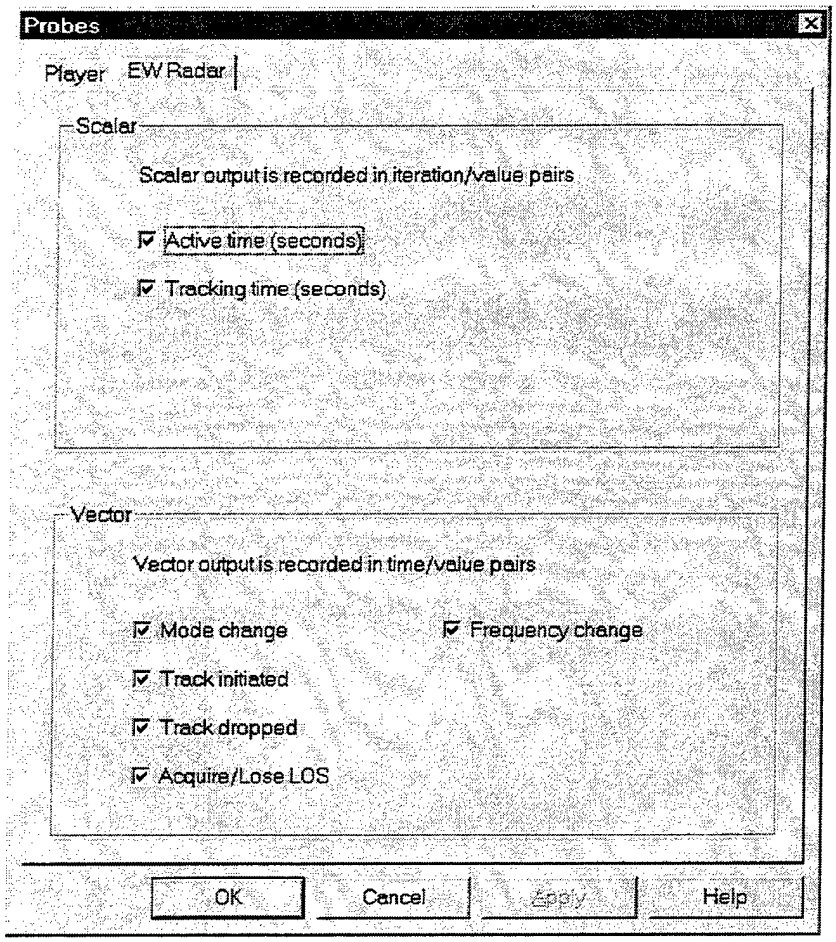

Figure 12-10. Radar Probe Dialog

(1) Scalar. Selecting any option in this block creates an output file labeled "S_*.txt" containing the identified post-processing output for the select player.

- Active Time: Outputs the total illumination time of the radar associated with the selected player.
- Tracking Time: Outputs the total time of the radar associated with the selected player is actively tracking a target.

(2) Vector. Selecting any option in this block creates an output file labeled "V_*.txt" containing the identified post-processing output for the select player.

- Mode Change: Outputs the time instances when radar initiates a mode change.

- Tracking Initiated: Outputs the time instances when a radar initiates track against a particular target.

- Tracking Dropped: Outputs the time instances when a radar drops track against a particular target.

- Acquired / Lose LOS: Outputs the time instances when LOS is acquired or dropped against a particular target.

- Frequency Change: Outputs the time instances when a radar initiates a frequency change.

The **Network** page, as shown in Figure 12-11, contains two fundamental blocks of information as described in detail below.

(1) Scalar. Selecting any option in this block creates an output file labeled "S_*.txt" containing the identified post-processing output for the select player.

- Transmit Utilization: Outputs the percentage of time that this player was in the process of transmitting data on the given network for this iteration.

- Max Queue Size: Outputs the maximum amount of data that was in the queue for this network.

- Average Queue Delay: Outputs the average delay that a packet experienced on this network for this player.

- Max Queue Delay: Outputs the maximum delay that a packet experienced.

(2) Vector. All vector data is time/value pairs and appears in the V_*.txt file for the player.

- Packet Statistic on Receive: Outputs the time the packet was received as well as the delay incurred from the time it was first entered into the sending player's queue.

- Packet Statistic on Transmit: Outputs the time the packet was transmitted as well as the delay incurred at this node (i.e., the time of transmission minus the time the packet was entered into the queue).

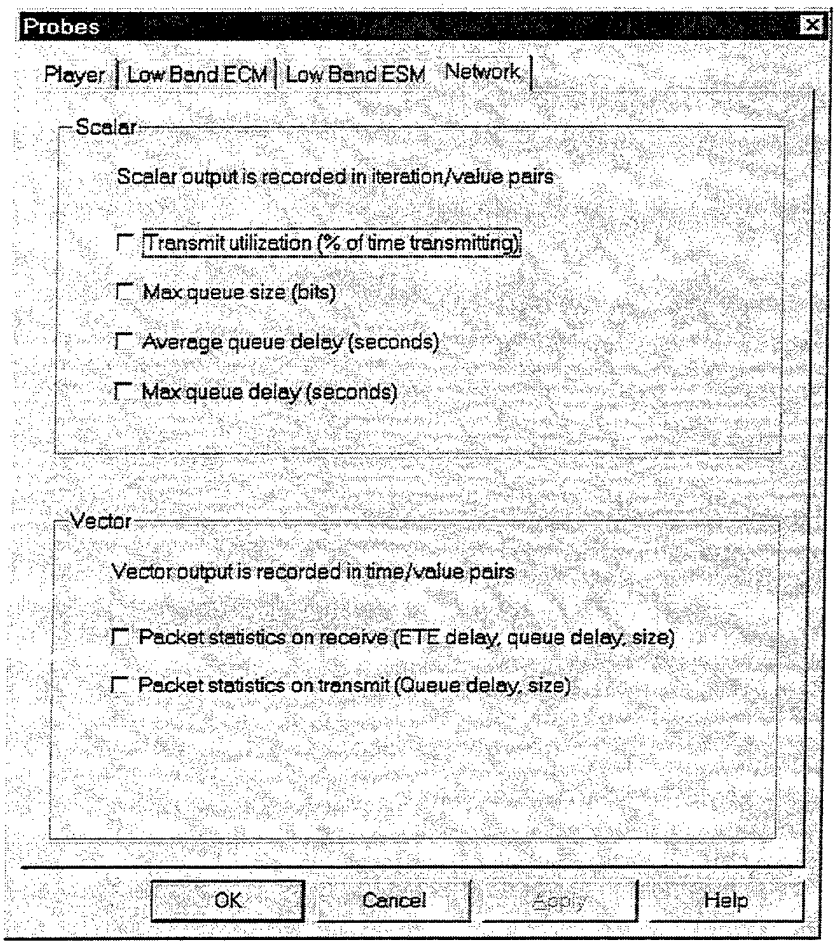

Figure 12-11. Network Probe Dialog

B. EDITING A PLAYER

Double-clicking an object from the Players tab of the Scenario Workbook opens a dialog for editing. The result of this action is the same as double-clicking the object from the Edit view. In general, the dialog is a combination of several pages as described below.

1. Identification

The Identification page, shown in Figure 12-12, is displayed for every player and contains several properties to be defined as described below.

Site: This is a text string that is used to identify the player in ARES. It is imperative that the users define a concise, but descriptive name for player.

Sequence: This is a numeric string that is uniquely identify the player to ARES. Players in the scenario can be assigned the same name, but different sequence number for identification.

Force: This box allows the users to specify from a drop-down whether the selected player is friend, foe, or neutral. This affects only the color with which that force is displayed (Friend: blue, Foe: red, Neutral: grey).

Status: This information is contained in the MSFD files and is not used in ARES.

Function: This can be used for filtering purposes. When the users use the ARES filter function, it will ask the users for function codes to keep.

Time Frame: This can be used for filtering purposes.

2. Position

This page, shown in Figure 12-13, is displayed when the selected player is of "static" type and allows the users to specify the position of the player in term of latitude and longitude.

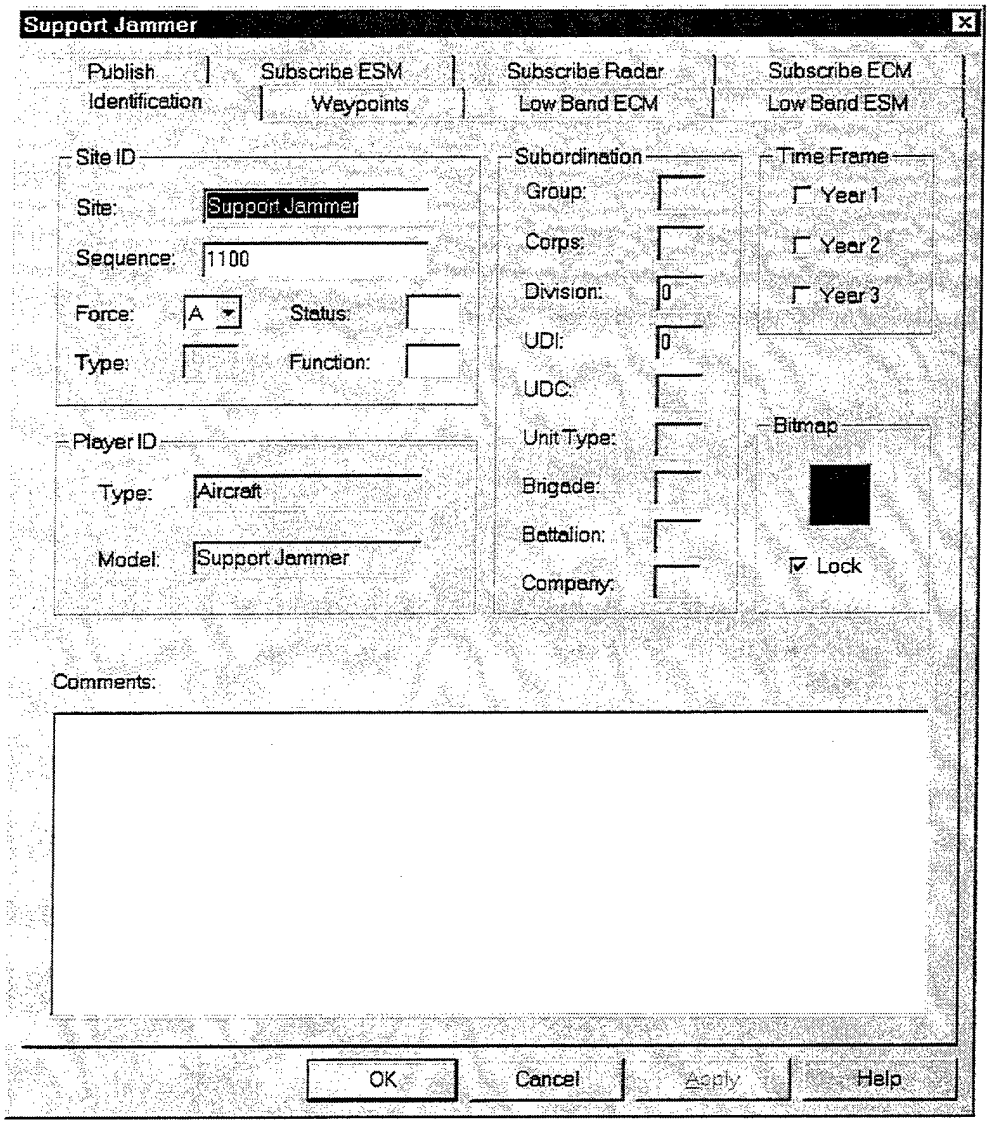

Figure 12-12. Player's Identification Properties Dialog

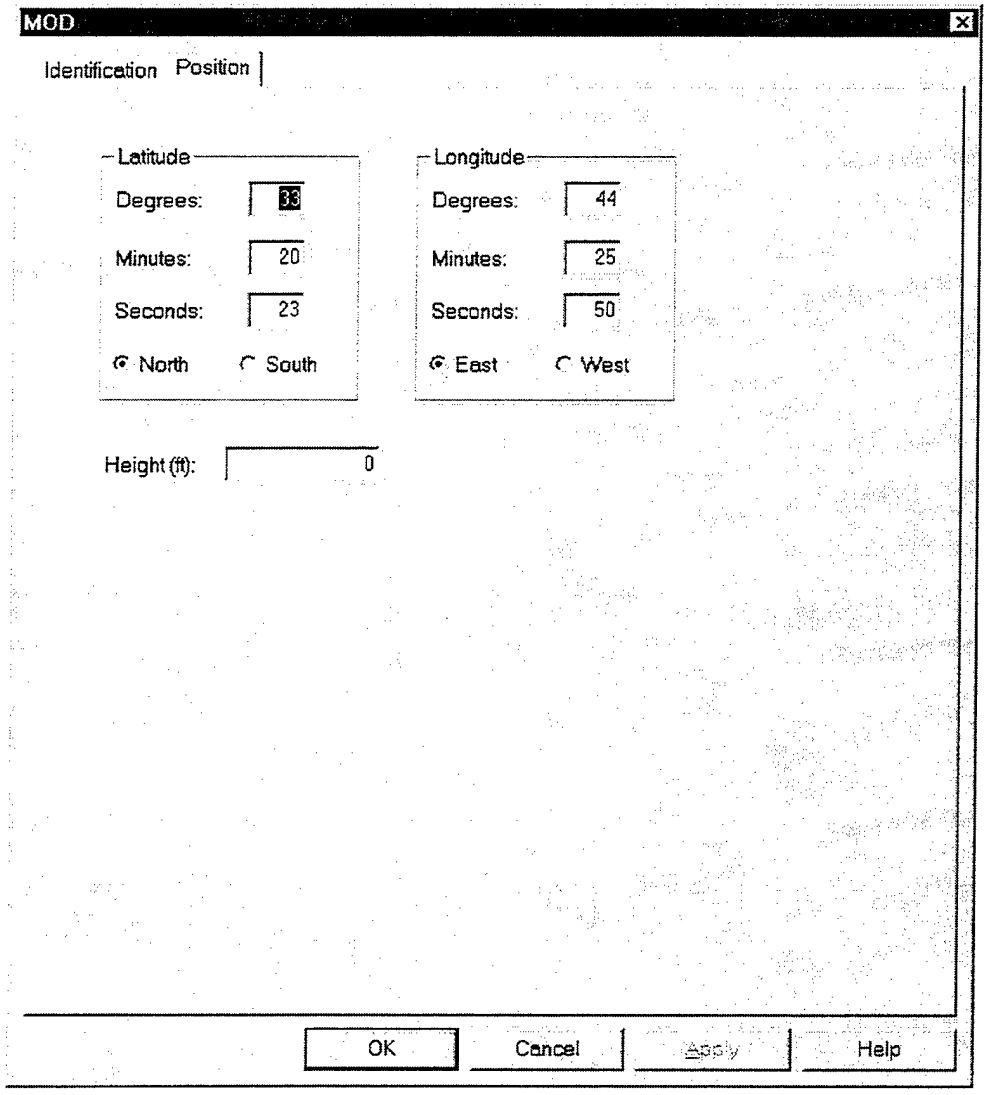

Figure 12-13. Player's Position Dialog

3. Waypoints

The Waypoints page, shown in Figure 12-14, is displayed when the selected player is of any type other than "static" and contains several properties allowing the users to specify the route leg of the player, as described below.

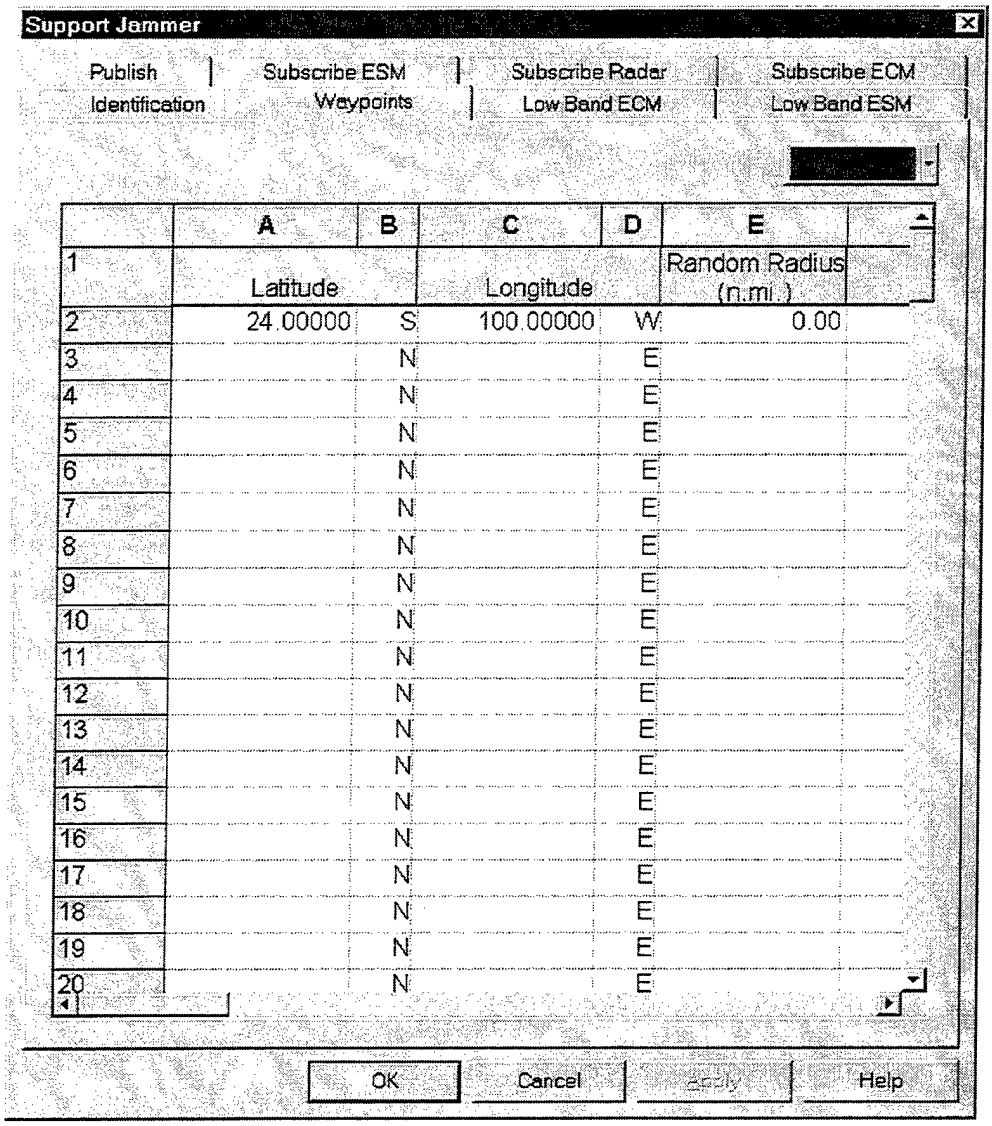

Figure 12-14. Player's Waypoints Dialog

Latitude: This input field is used to identified the desired latitude location of the player. Valid format for this field is DD.MMSSFF where D=degrees, M=minutes, S=seconds, and F=fraction of second. The toggle button to the right of the latitude data entry field is used to specify the reference with respect to the equator.

Longitude: This input field is used to identify the desired longitude location of the player. Valid format for this field is DD.MMSSFF where D=degrees, M=minutes, S=seconds, and F=fraction of second. The toggle button to the right of the longitude data entry field is used to specify the reference with respect to the true north.

Random Radius: Any number greater than zero in this field results in the player appearing somewhere within a circle equal to the specified radius and centered on the waypoint latitude and longitude.

Altitude: This field specifies the player altitude in feet that ARES will use to evaluate detection coverage. The toggle button to the right of the altitude data entry field is used to specify the reference for computing the altitude measurements for analysis, AGL (Above Ground Level) and MSL (Mean Sea Level).

Marker: Specifies what type of point this is.

- Waypoint: If this marked as a waypoint, then the platform will pass through this point.
- Orbit: If this is marked as an orbit point, then the platform will orbit this point at a radius determined by the platform speed and G's in the turn. It will orbit this point for a period of time indicated in the delay columns.

Speed: This field specifies the player traveling speed in knots between waypoints.

G's in Turn: This field specifies the players G limit during turn. This impacts the bank angle and time to turn through a waypoint.

Delay in Minutes: If specified in the first row and marked as waypoint, this is the time in minutes at which this player will enter the scenario and begin moving. If this is an orbit point, then this is the time that the platform will orbit this point.

Delay in Seconds: If specified in the first row and marked as waypoint, this is the time in seconds at which this player will enter the scenario and begin moving. If this is an orbit point, then this is the time that the platform will orbit this point.

Color Box: Clicking the cell displays a dialog to change the color of the drawed line connecting the selected player's waypoints.

4. System

This page is displayed for each system associated with the model that the player is based on. The dialog page for radar, ESM, and ECM is identical with the exception of the dialog heading. A sample ECM dialog page is provided in Figure 12-15. As shown, the dialog page contains four fundamental blocks of information. These are described in detail below.

Minutes: Defines the time in minutes at which the mode will be activated.

Seconds: Defines the time in seconds at which the mode will be activated.

Mode: Single-click on the cell allows the users to specify a particular mode from the drop-down list to be activated. The modes available to the users are those that were created under the Systems tab for the selected system.

Dynamic Mode Selection: Selecting this option activates a dialog box listing modes available to the chosen system for selection to be dynamically activated when cued to do so by a C3 node player. The mode available to the users are those that were created under the Systems tab for the selected system.

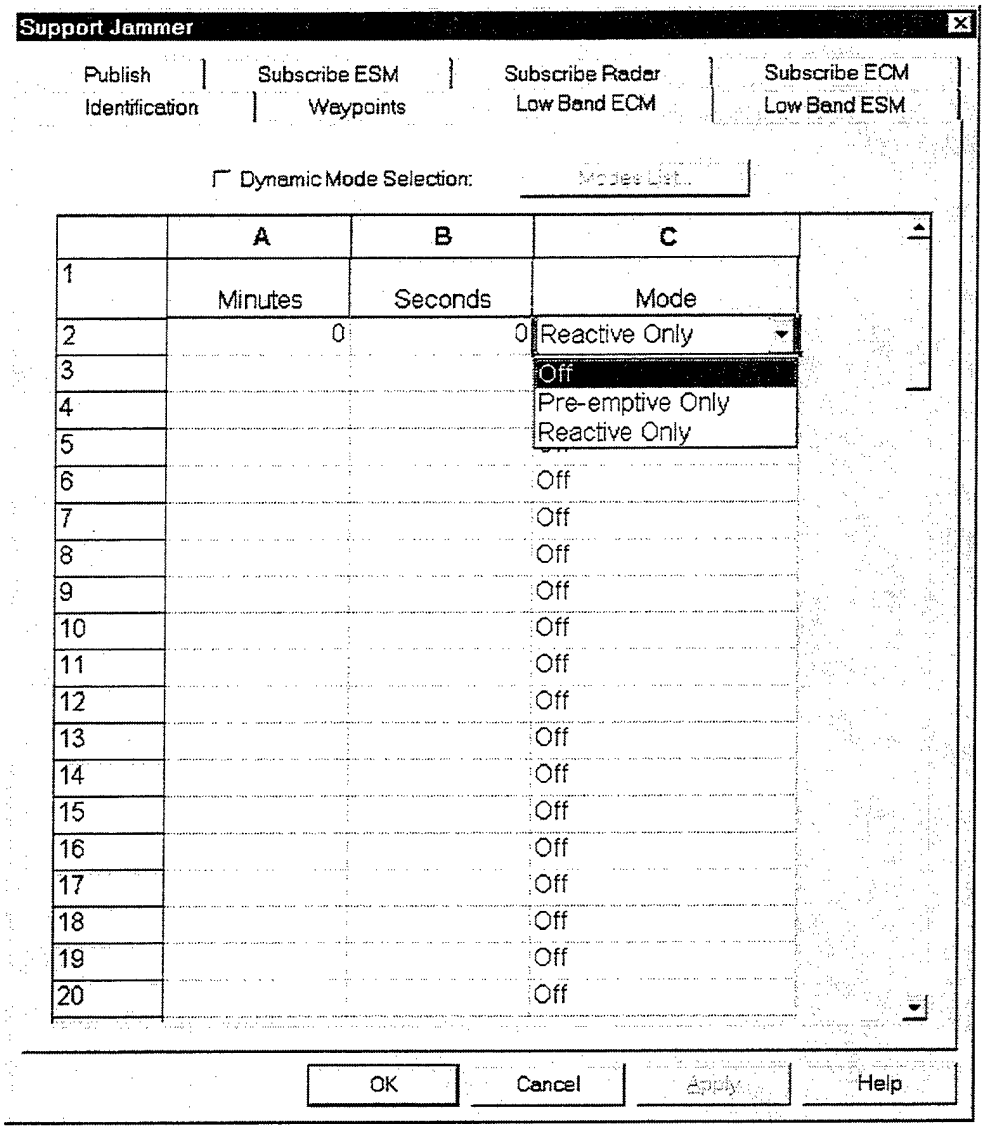

Figure 12-15. Sample of the Player's ECM System Dialog

5. Publish

The Publish page, as shown in Figure 12-16, is displayed only when the players is a network participant. It contains seven fundamental blocks of information to be specified for network transmission. These are described in detail below.

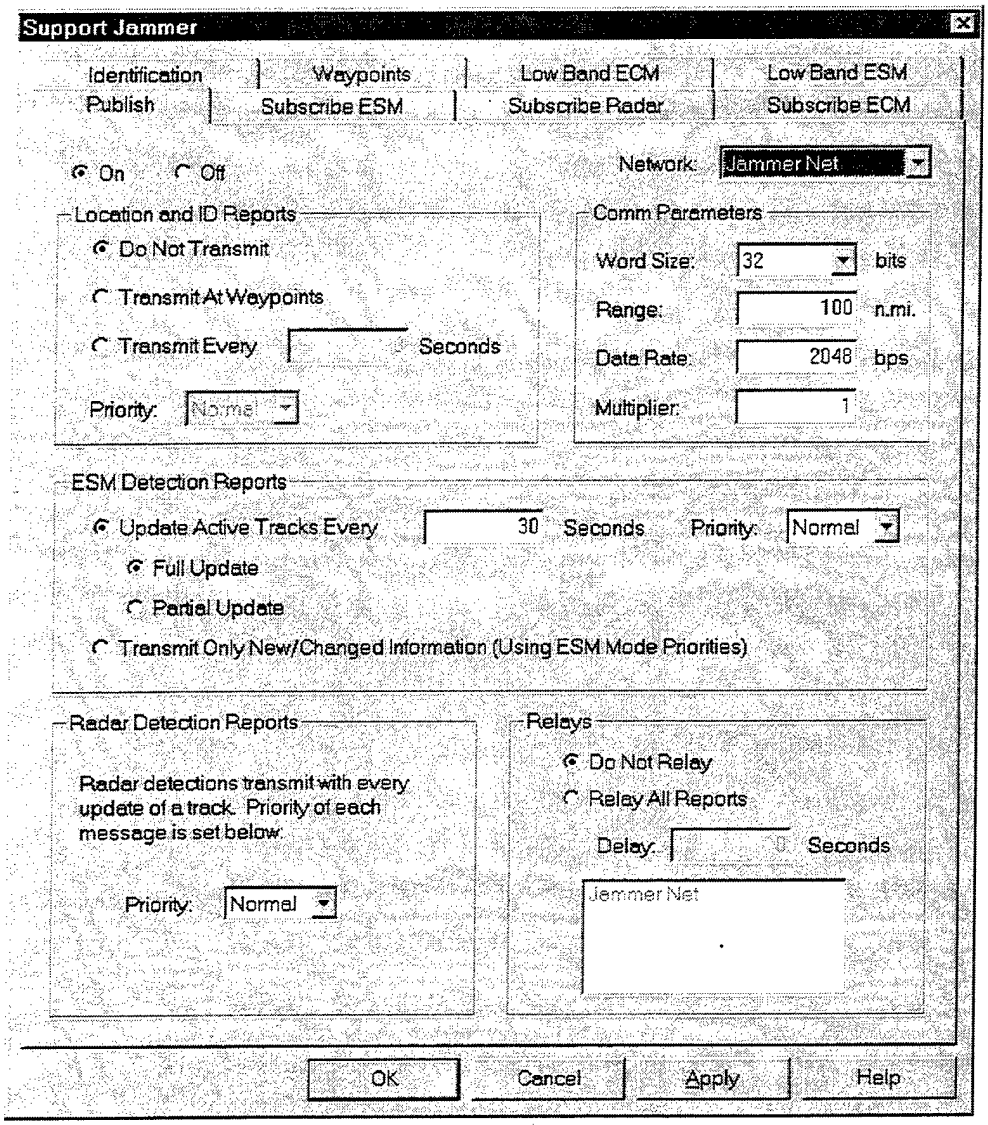

Figure 12-16. Player's Publish Dialog

ON / OFF: Select the radio button indicating whether the player is active on this network (transmit and receive).

Network: Clicking the cell displays a drop-down menu listing networks of which the selected player is a member for selection to transmit information on.

Location and ID Reports: Provides the users with options to control the frequency that updates Location and ID reports of this player to other participants on the network. If the transmission to be done at a fixed interval, the users must also specify the priority for message handling. Depending on the priority, network places the packet into 1 of 3 queues. High priority is to be processed first. If there is bandwidth left over, network processes normal priority second. If there is still bandwidth left over, it processes low priority packets last.

Comm Parameters: Allows the users to specify the parameters for network communication.

- Word Size: Specifies the word size in number of bits.
- Range: The distance over which this player can fling a packet on this network.
- Data Rate: Specifies transfer rate in bits per second.
- Multiplier: Models the increase in word size to account for error correction coding and repeated transmissions by the communication device (i.e., the packet size will be increased by the multiplier entered here).

ESM Detection Reports: Provides the users with options to control the frequency that updates ESM Detection Reports of this player to other participants on the network. When Transmits Only New/Changed Information radio button is selected, the network will broadcast only when there is new information to report. If the transmission to be done at a fixed interval, the users must also specify the priority and scheme for information update. Depending on the priority, network places the packet into 1 of 3 queues. High priority is to be processed first. If there is bandwidth left over, network

processes normal priority second. If there is still bandwidth left over, it processes low priority packets last.

- Partial Update: Periodically broadcast just enough information to let the world the know the status of information transmitted before.
- Full Update: Rebroadcast everything periodically. This is selected if the users require high transmission reliability and cannot be certain of successful transmission each and every time.

Radar Detection Reports: Provides the users with options to set the priority for network transmission of radar detection update message. Depending on the priority, network places the packet into 1 of 3 queues. High priority is to be processed first. If there is bandwidth left over, network processes normal priority second. If there is still bandwidth left over, it processes low priority packets last.

Relays: Select the radio button indicating whether the users want the selected network to remit information to another network specified by the users and of which the player is a member.

6. Subscribe ESM

The Subscribe ESM page, as shown in Figure 12-17, is displayed only when the player is a network participant. It contains a list of information that can be requested by this player from a network. If the **Subscribe** radio button is selected, players will issue a request to receive the selected information from the network specified by the users and of which it is a member. Other players on the same network will transmit the requested information only if they possess an ESM system that offers this information on their Report page. A request for information by a player on their Subscribe page is no

guarantee that they will actually have their request fulfilled. The information requested is described below.

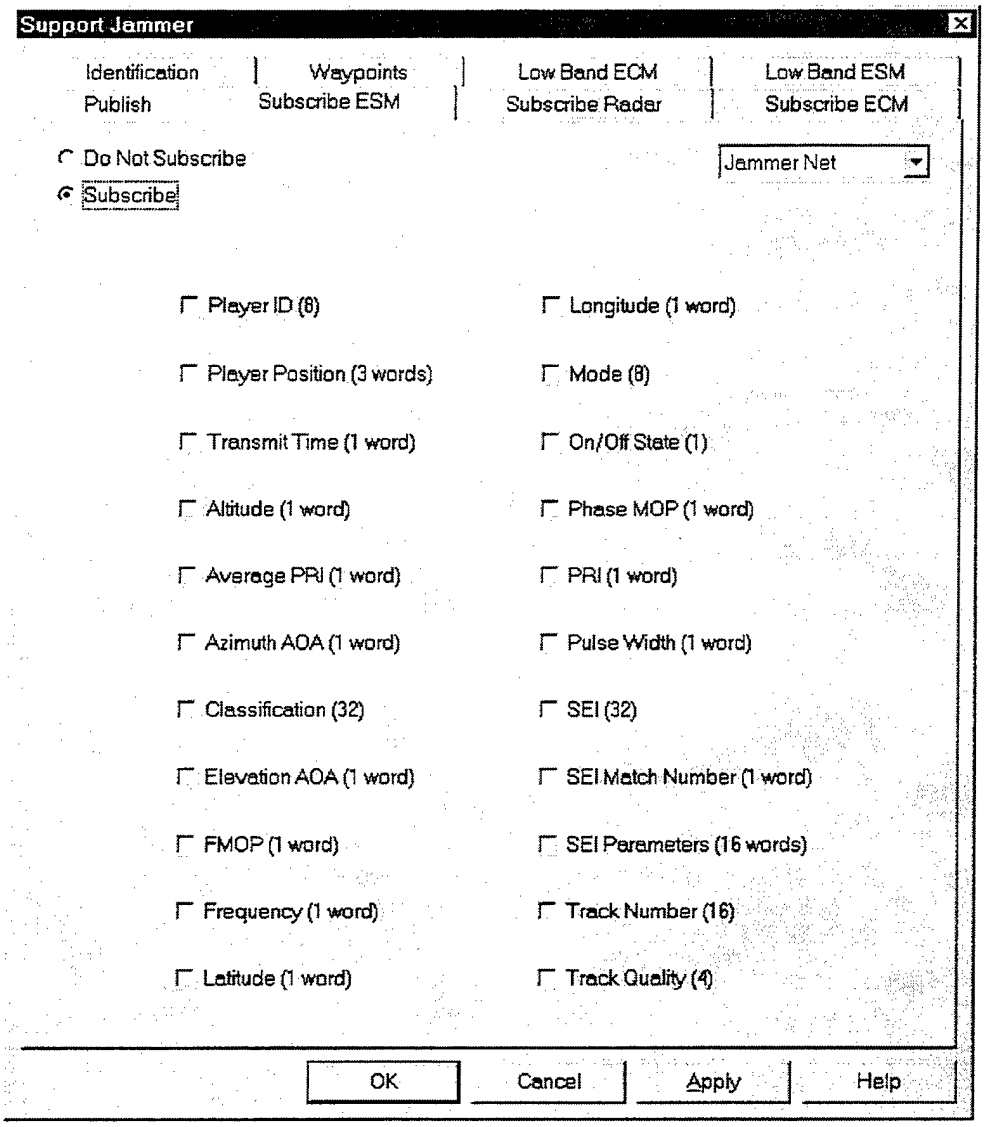

Figure 12-17. Player's Subscribe ESM Dialog

Player ID: This is an 8-bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

Player Position: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying the player's current position.

Transmit Time: This is a single word that identifies the time at which the packet was created. Select this if the users want each packet to have a time-stamp indicating the age-of-the information to its recipients.

Altitude: This is a single word representing the altitude of the detected player which is being reported in this packet. Selecting this parameter implies that the ESM has the ability to resolve and report altitude.

Average PRI: This is a single word representing the average PRI of the reported emitter.

Azimuth AOA: This is a single word representing the azimuth angle of arrival of the reported emitter.

Classification: This is 32-bit parameter uniquely identifying the classification of the reported emitter.

Elevation AOA: This is a single word representing the elevation angle of arrival of the reported emitter.

FMOP: This is a single word representing the frequency modulation on pulse (e.g., chirp) of the reported emitter.

Frequency: This is a single word representing the frequency of reported emitter. If there are multiple frequency, then one word will be generated per PRI.

Latitude: This is a single word representing the latitude of the reported emitter.

Longitude: This is a single word representing the longitude of the reported emitter.

Mode: This is 8-bit parameter uniquely identifying the mode of the reported emitter.

On/Off State: This is a single word representing the status of the reported emitter (on or off).

Phase MOP: This is a single word representing the phase coded waveforms (e.g. barker code) of the reported emitter.

PRI: This is a single word representing the PRI of the reported emitter. If there are multiple PRI, then one word will be generated per PRI.

Pulse Width: This is a single word representing the pulse width of the reported emitter.

SEI: This is a 32-bit parameter representing the unique identification of the emitter (if the receiver has SEI capability).

SEI Match Number: This is a single word representing the quality of the identification.

SEI Parameters: This is 16 words representing the uniquely computed coefficients that were used to determine identification.

Track Number: This is a 16-bit parameter representing the locally assigned track number.

Track Quality: This is a 4-bit parameter representing the quality of the track.

7. Subscribe Radar

The Subscribe Radar page, as shown in Figure 12-18, is displayed only when the players is a network participant. It contains a list of information that can be requested by this player from a network. If the **Subscribe** radio button is selected, players will issue a request to receive the selected information from the network specified by the users and of which it is a member. Other players on the same network will transmit the requested information only if they possess a radar system that offers this information on their Report page. A request for information by a player on their Subscribe page is no guarantee that they will actually have their request fulfilled. The information requested is described below.

Player ID: This is an 8 bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

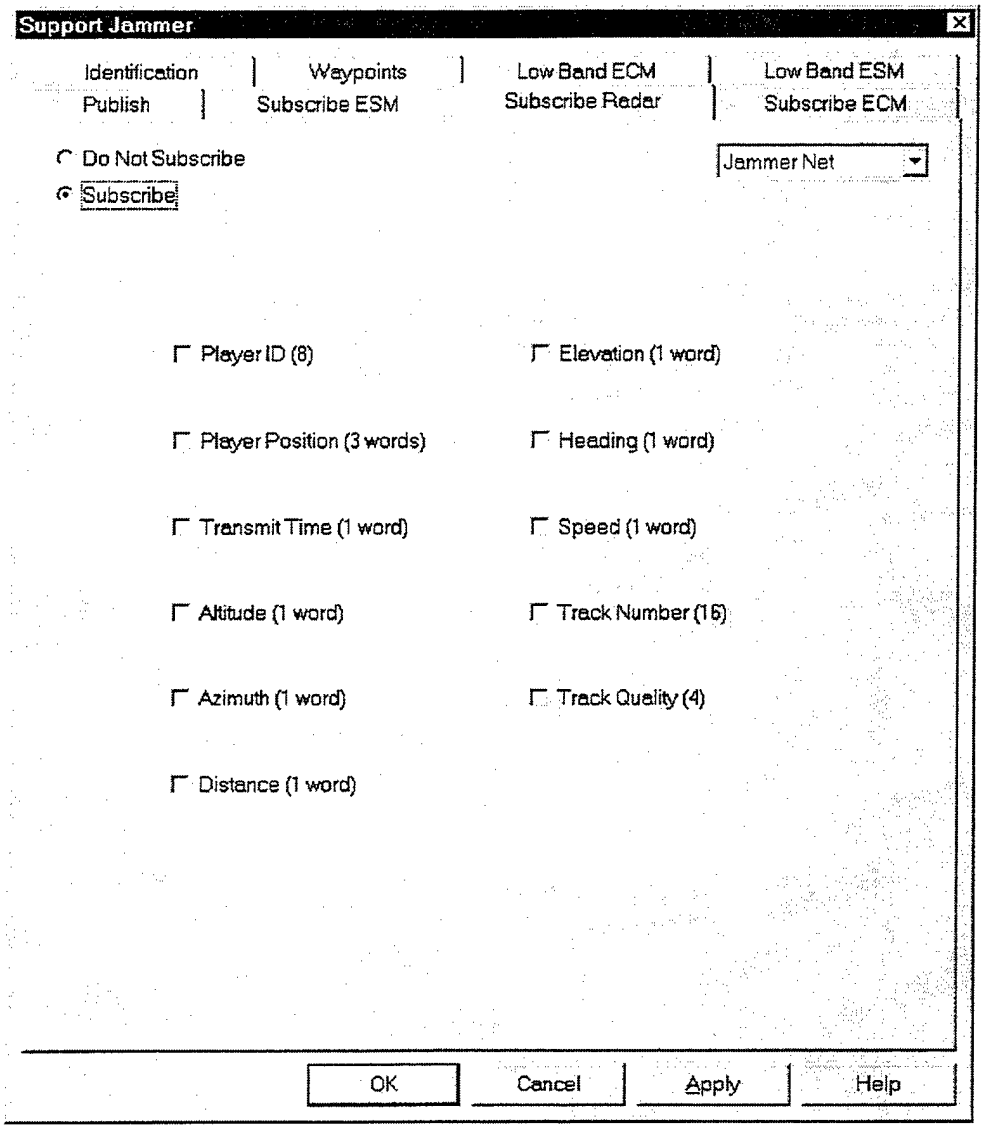

Figure 12-18. Player's Subscribe Radar Dialog

Player Position: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying the player's current position.

Transmit Time: This is a single word that identifies the time at which the packet was created. Select this if the users want each packet to have a time-stamp indicating the age-of-the information to its recipients.

Altitude: This is a single word representing the altitude of the track which is being reported in this packet. Selecting this parameter implies that the radar has the ability to resolve and report altitude (i.e., it is either a 3-D radar or a height-finder).

Azimuth: This is a single word representing the azimuth angle of the reported track.

Distance: This is a single word representing the distance of the reported track.

Elevation: This is a single word representing the elevation angle of the reported track.

Heading: This is a single word representing the heading of the reported track. Selecting this parameter implies that the radar has the ability to resolve and report the heading of the track.

Speed: This is a single word representing the speed of the reported track. Selecting this parameter implies that the radar has the ability to resolve and report the speed of the track.

Track Number: This is a 16 bit parameter representing the locally assigned track number.

Track Quality: This is a 4-bit parameter representing the quality of the track.

8. Subscribe ECM

The Subscribe ECM page, as shown in Figure 12-19, is displayed only when the players is a network participant. It contains a list of information that can be requested by this player from a network. If the **Subscribe** radio button is selected, players will issue a request to receive the selected information from the network specified by the users and of which it is a member. Other players on the same network will transmit the requested information only if they possess an ECM system that offers this information on their Report page. A request for information by a player on their Subscribe page is no guarantee that they will actually have their request fulfilled. The information requested is described below.

Player ID: This is an 8 bit parameter uniquely identifying the player to the network. Select this if the users want each packet to contain a field identifying the source of the information.

Player Position: This is three words containing the player's latitude, longitude, and height. The size of the word is determined at the player level. Select this if the users want each packet to contain a field identifying player's current position.

Transmit Time: This is a single word that identifies the time at which the packet was created. Select this if the users want each packet to have a time-stamp indicating the age-of-the information to its recipients.

Track Number: This is a 16 bit parameter representing the locally assigned track number.

Engaged/Disengaged: This is a 1-bit parameter identify if the track is engaged or disengaged.

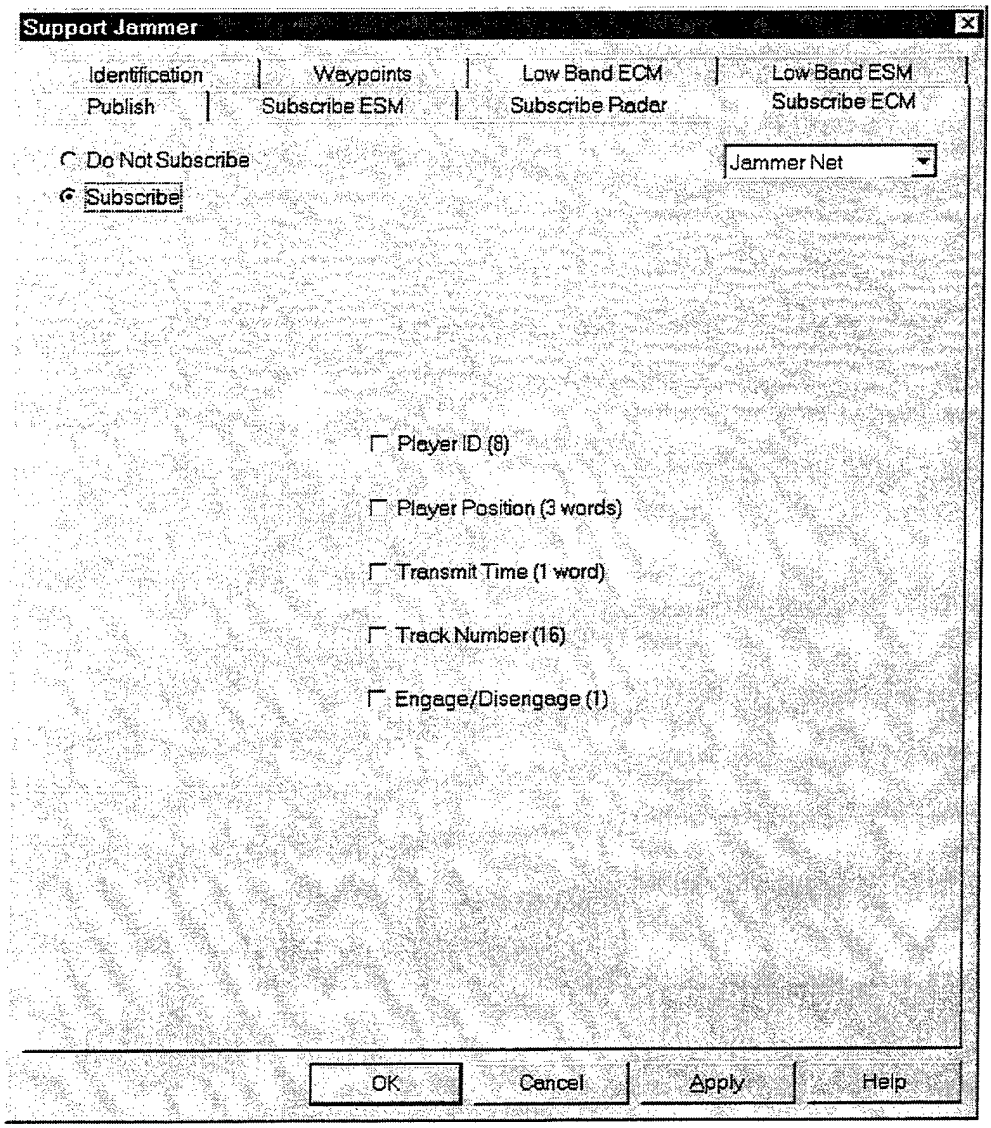

Figure 12-19. Player's Subscribe ECM Dialog

XIII. EXECUTE VIEW

The Execute view is the second of the three views available for a document. It is activated by selecting the "Execute" tab along the bottom of the current document's frame. This view displays a screen for text output which provides feedback from an executing scenario, as shown in Figure 13-1. In Execute view executing scenario commands are accessed via the Run Control Toolbar.

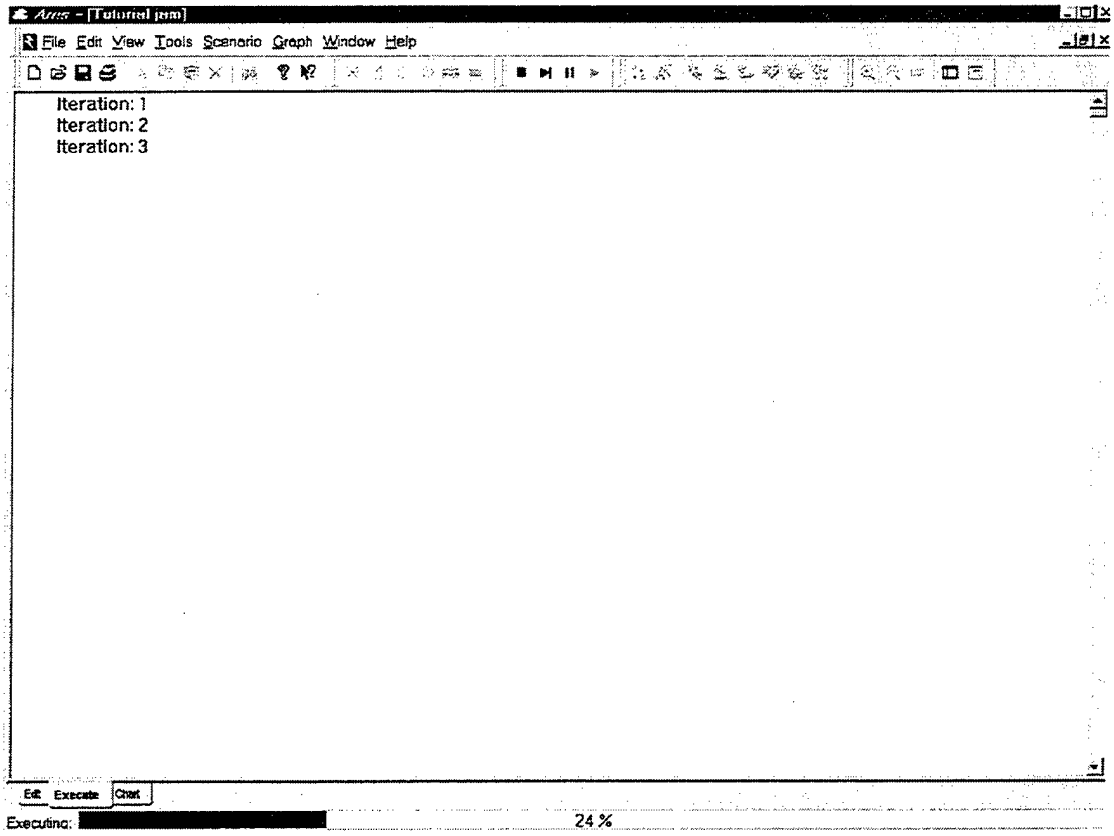

Figure 13-1. Sample of Execute View Window

A. RUNTIME CONTROL BAR WINDOW

The Runtime Control Bar are where execution parameters editing activities takes place. It is displayed whenever the Execute view is active and features three tabs, as shown in Figure 13-2, representing three processing algorithms as described below.

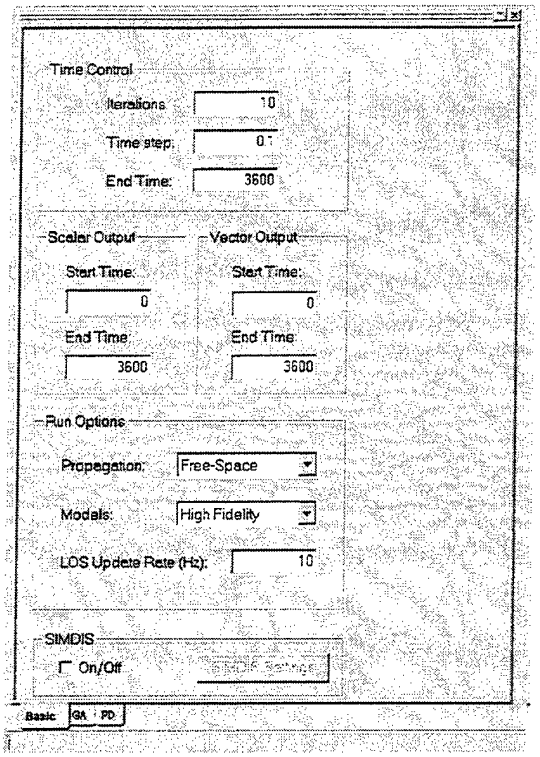

Figure 13-2. Basic Runtime Control Bar Window

1. Basic

Executing from this page invokes the conventional algorithm in ARES for computing complex interaction of multiple radar systems being acted upon by multiple airborne ECM aircraft, considering target aircraft radar cross section and altitude, terrain masking effects, both standoff jamming and self protection jamming effects, and network connection effect. As shown in Figure 13-2, input parameters to the Basic processing are organized into five fundamental blocks of information described as follows.

Time Control: Allows the users to define the number of trials, the execution time interval, and time step.

Scalar Output: Allows the users to define the start and end time for exporting scalar data specified in Probes dialog.

Vector Output: Allows the users to define the start and end time for exporting vector data specified in Probes dialog.

Run Options: Allows the users to select the model and set LOS Update rate.

- High Fidelity: The high fidelity model will use ESMs that will actually sample the environment in time according to the tune schedule specified by their current mode.
- Low Fidelity: The low fidelity model will use ESMs that will declare detection against radars for which they have sufficient sensitivity to detect their backlobe emissions. This model does not follow the tune schedule and, therefore, is more computationally efficient at the expense of accuracy.
- LOS Update Rate: Typically this value is set to 1/time step in Hz.

SIMDIS: The users have the option of exporting data that can be read into SIMDIS for high-performance visualization. Selecting this box activates the "SIMDIS Settings" button with which the users can access a dialog to select what to have output to SIMDIS, as shown in Figure 13-3. When ARES is executed, an output file with an extension of ".asi" is created for use with SIMDIS software, a product of NRL ENEW Division [Ref. 3].

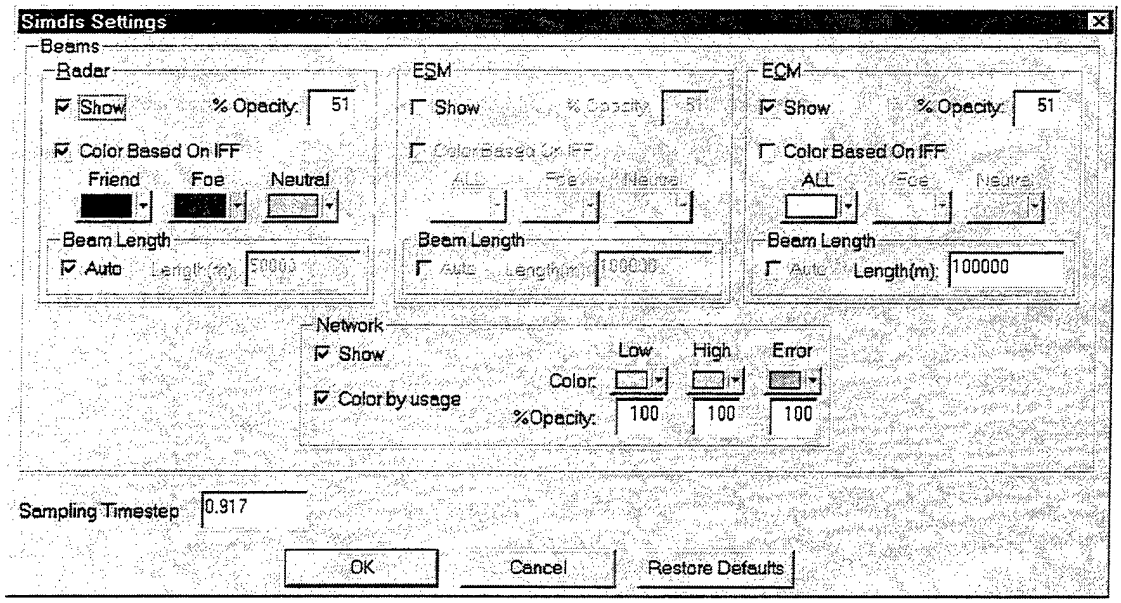

Figure 13-3. SIMDIS Settings Dialog

2. GA

Executing from this page invokes the Genetic Algorithm to produce an optimized configuration of what the core and peripheral components of the AEA architecture should be. To effectively utilize this function, knowledge of the GA concept is required. A detailed description of GA theory can be found in the text written by David Goldberg [Ref. 2]. As shown in Figure 13-4, there are six input parameters to be specified for the process. The definition of each parameter is as follows:

Generations: Defines the number of generations to execute the GA.

Population Size: Defines the number of individuals in the GA population.

Pcrossover: Defines the probability that any individual will experience genetic crossover in the creation of children.

Pmutation: Defines the probability that any gene in an individual will mutate.

Elitism: If on, the GA will employ elitism.

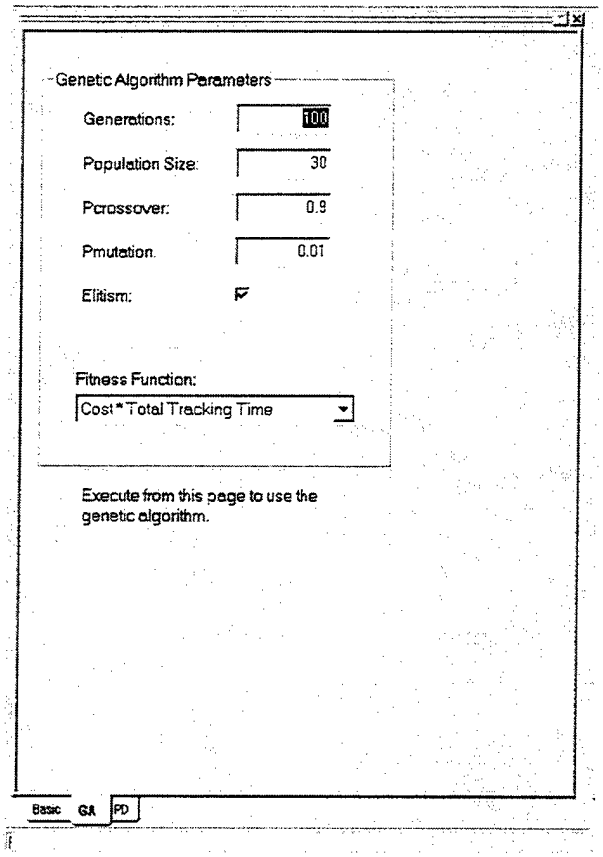

Figure 13-4. GA Runtime Control Bar Window

Fitness Function: Contains a list of six MOE objective function values for selection to compute an optimal GA solution. The definition of each objective function is as follows:

- Cost * Total Tracking Time: This function is obsolete and can be ignored.
- Total Tracking Time: Minimize the cumulative tracking time of the strike aircraft by the ground emitters which have been flagged as being probed.
- Emitters Detected: Maximize the percentage of the ground emitters detected by the airborne ESM systems.
- Target Engagements: Minimize the number of SAM engagements of strike interceptor. Two criteria have to be met to be considered a successful engagement: 1) the strike aircraft has to be tracked by the tracking mode of the radar, and 2) the strike aircraft has to be within the SAM engagement envelope. An engagement is considered to occur the first time these

conditions are met. Intermittent engagements or additional engagements by the same threat are not considered to be an engagement.

- Time Targets Engaged: As depicted in Figure 13-5, this minimizes the amount of time the strike aircraft are engaged by the SAM systems.
- Sum Time Targets Engaged: As depicted in Figure 13-5, this minimizes the cumulative sum of the individual SAM engagement times of the strike aircraft.

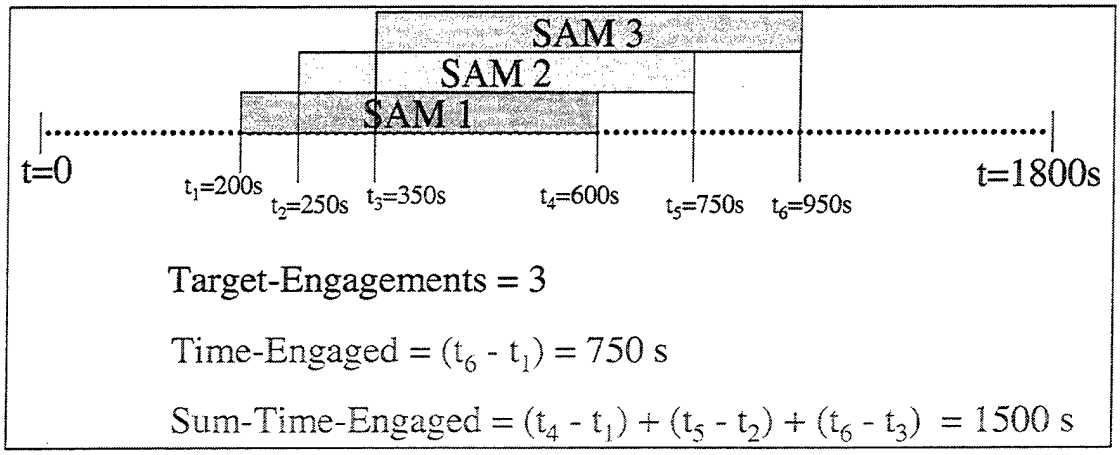

Figure 13-5. MOEs Graphical Explanation

3. PD

Executing from this page invokes the algorithm to produce jamming power density map. The users can then display the results on the Edit view. As shown in Figure 13-6, there are four input parameters required for the process. The definition of each parameters is as follows:

Resolution: This is the resolution of the grid that will produce the power density map (i.e., the pixel size).

Period: This is the time period for taking "snapshots" of the power density. For example, if the Period is 30 seconds, then power density contours will be produced every 30 seconds of simulated time.

Elevation: This is the elevation at which the power density should be measured. A value of zero here will show the power density measured on the surface of the terrain. If the users want to represent what a typical radar antenna would see, then enter a value around 15 feet (average height of a radar antenna).

Set Frequencies: Button, when depressed, opens a dialog allowing the users to specify the frequency ranges over which to collect power density maps. For example, if the users enter 150 – 200 MHz as a frequency range, then ARES will create a power density map of all jammer power that falls within 150 – 200 MHz.

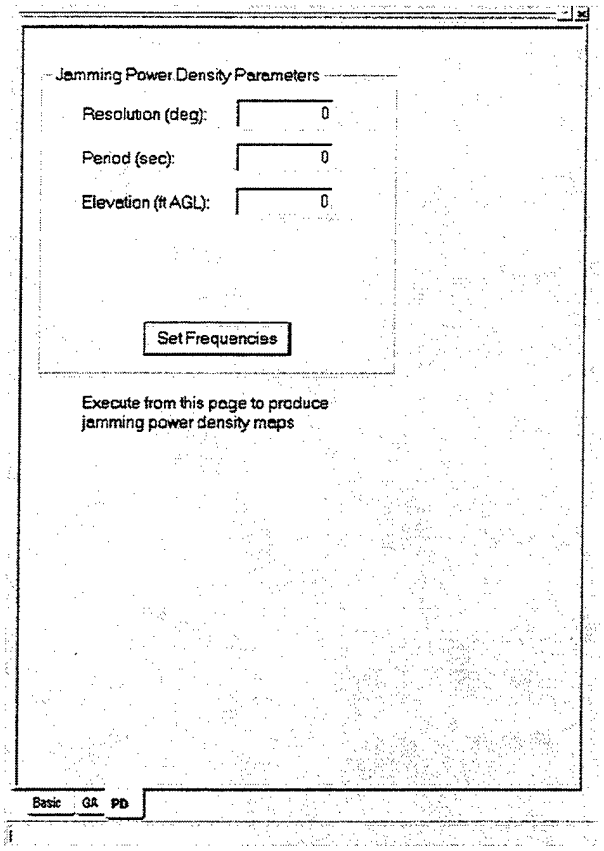

Figure 13-6. PD Runtime Control Bar Window

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XIV. CHART VIEW WINDOWS

The Chart view is the last of the three views available for a document. It is activated by selecting the "Chart" tab along the bottom of the current document's frame. This view displays graphs of post-processed run output based on selection from the Post-proc Control Bar described in the following sections.

A. POST-PROC CONTROL BAR WINDOW

The Post-proc Control Bar is where the users can select a particular post-processed performance parameters for output. It is displayed whenever the Chart view is active and features four tabs as describe below.

1. Radar

The Radar page, shown in Figure 14-1, lists nine chart options available for evaluating radar performance. These options are divided into two fundamental blocks as described below. For each option, the data available for plotting are those that were flagged for output on the Radar Probes dialog under the Players tab.

Single Iteration: Displays the selected performance parameter for a specified iteration.

- Multi-Radar Detection History: Presents dialogs for specifying the radar systems, target site, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the detection performance over time for every specified radar systems against the elected target site.

- Multi-Radar Detection Histogram: Presents dialogs for specifying the radar systems, target site, time interval, iteration, and iteration of interest, in addition to number of bins. ARES then displays a clustered column chart in the Chart view window illustrating the detection distribution over time for every radar systems specified by the users. In general, histogram chart provides two purposes. One is to give a feeling for the degree to which a

platform is detectable at any point in time. The second is that the area under the histogram is equivalent to the total tracking time MOE.

- Single-Radar Detection History: Presents dialogs for specifying a radar systems, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the detection performance over time for the selected radar system.

- Single-Radar Detection Histogram: Presents dialogs for specifying a radar systems, time interval, and iteration of interest, in addition to number of bins. ARES then displays a clustered column chart in the Chart view window illustrating the detection distribution over time for the selected radar system. In general, histogram chart provides two purposes. One is to give a feeling for the degree to which a platform is detectable at any point in time. The second is that the area under the histogram is equivalent to the total tracking time MOE.

All Iteration: Displays the selected performance data for all iterations.

- Single Radar Frequency Change: Presents dialogs for specifying the radar systems and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when frequency changes occur over time for the identified radar system.

- Single Radar Mode Change: Presents dialogs for specifying the radar systems and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when mode changes occur over time for the identified radar system.

- Single Radar Acquire LOS: Presents dialogs for specifying the radar systems and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when the target LOS is first acquired by the identified radar system.

- Single Radar Detection Ranges: Presents dialogs for specifying the radar systems and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating the range in nautical miles at which the target is first detected by the identified radar system.

- Multiple Radar Detection Ranges: Presents dialogs for specifying the radar systems and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating the range in nautical miles at which first detection occurs for every identified radar systems.

Export Data: Prompts the users for the name of a text file to write the selected performance data into. This file may be read into other programs for further analysis (e.g., Microsoft Excel).

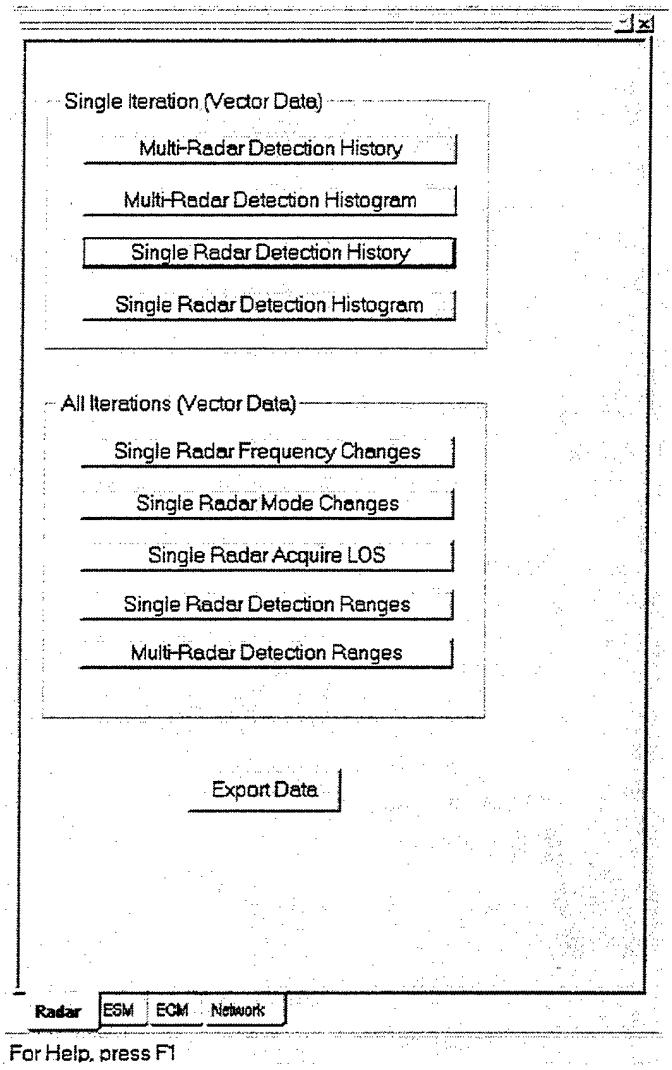

Figure 14-1. Radar Post-proc Control Bar

2. ESM

This ESM page, shown in Figure 14-2, presents seven charting options available for evaluating an ESM performance. These options are divided into two fundamental blocks as described below. For each option, the data available for plotting are those that

were flagged for output on the ESM Probes dialog under the Players tab for the selected player.

Single Iteration: Displays the selected performance parameter for a specified iteration.

- Multi-ESM Detection History: Presents dialogs for specifying ESM systems, target site, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the detection performance over time for every identified ESM system.

- Single ESM Detection History: Presents dialogs for specifying an ESM system, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the detection performance over time for the identified ESM system..

- Multi-ESM Signal Density: Presents dialogs for specifying ESM systems, target site, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the signal density over time for every identified ESM system.

- Multi-ESM Pulse Density: Presents dialogs for specifying ESM systems, target site, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the pulse density over time for every identified ESM system.

All Iteration: Displays the selected performance parameter for all iterations specified in the Basic Runtime Control Bar.

- Single ESM Acquire LOS: Presents dialogs for specifying an ESM system and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when first LOS acquisition occurs over time for the identified ESM system.

- Multiple ESM Time-of-Detect: Presents dialogs for specifying ESM systems, target site, and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when first LOS acquisition occurs over time for every identified ESM system.

- Single ESM Time-of-Detect: Presents dialogs for specifying an ESM system and time interval of interest. ARES then displays a scattered plot in the Chart

view window indicating when first detection occurs over time for the identified ESM system.

Export Data: Prompts the users for the name of a text file to write the selected performance data into. This file may be read into other programs for further analysis (e.g., Microsoft Excel).

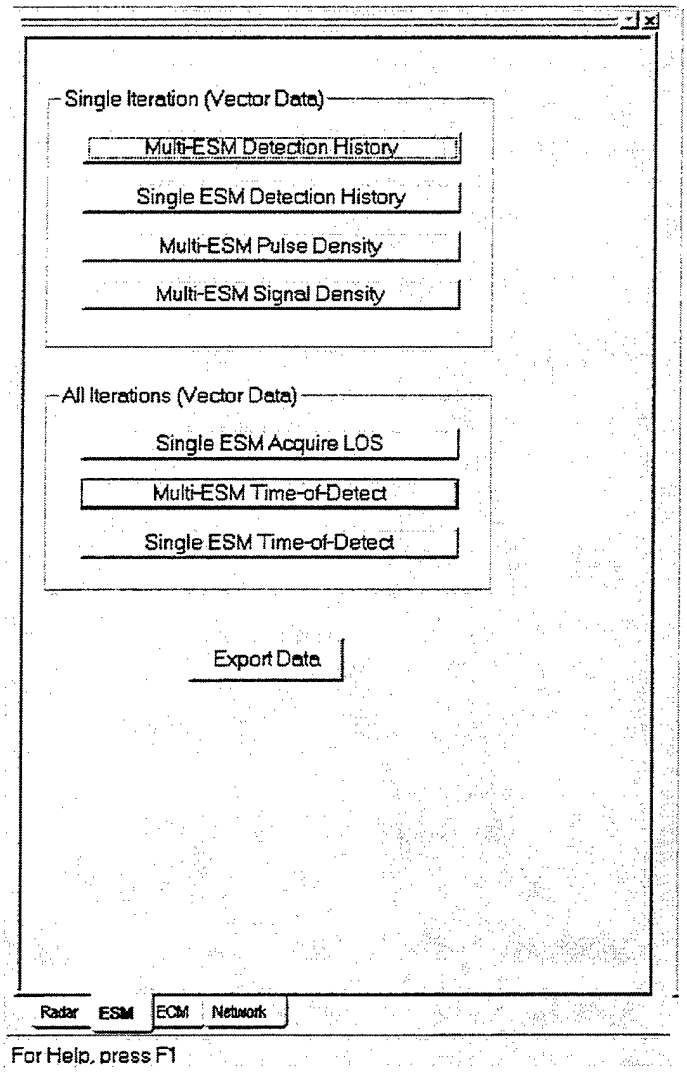

Figure 14-2. ESM Post-proc Control Bar

3. ECM

The ECM page, shown in Figure 14-3, presents four charting options for evaluating the ECM performance. These options are divided into two fundamental blocks as described below. For each option, the data available for plotting are those that were flagged for output on the ECM Probes dialog under the Players tab for the selected player.

Single Iteration: Displays the selected performance parameter for a specified iteration.

- Multi-ECM Jamming History: Presents dialogs for specifying ECM systems, target site, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the jamming performance over time for every ECM systems specified by the users.
- Single ECM Jamming History: Presents dialogs for specifying an ECM system, time interval, and iteration of interest. ARES then displays a clustered bar chart in the Chart view window illustrating the jamming performance over time for the identified ECM system

All Iteration: Displays the selected performance parameter for all iterations specified in the Basic Runtime Control Bar.

- Multiple ECM Time-of-Jam: Presents dialogs for specifying ECM systems, target site, and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when jamming first occurs over time for every identified ECM system.
- Single ECM Time-of-Jam: Presents dialogs for specifying an ECM system and time interval of interest. ARES then displays a scattered plot in the Chart view window indicating when jamming first occurs over time for the identified ECM system.

Export Data: Prompts the users for the name of a text file to write the selected performance data into. This file may be read into other programs for further analysis (e.g., Microsoft Excel).

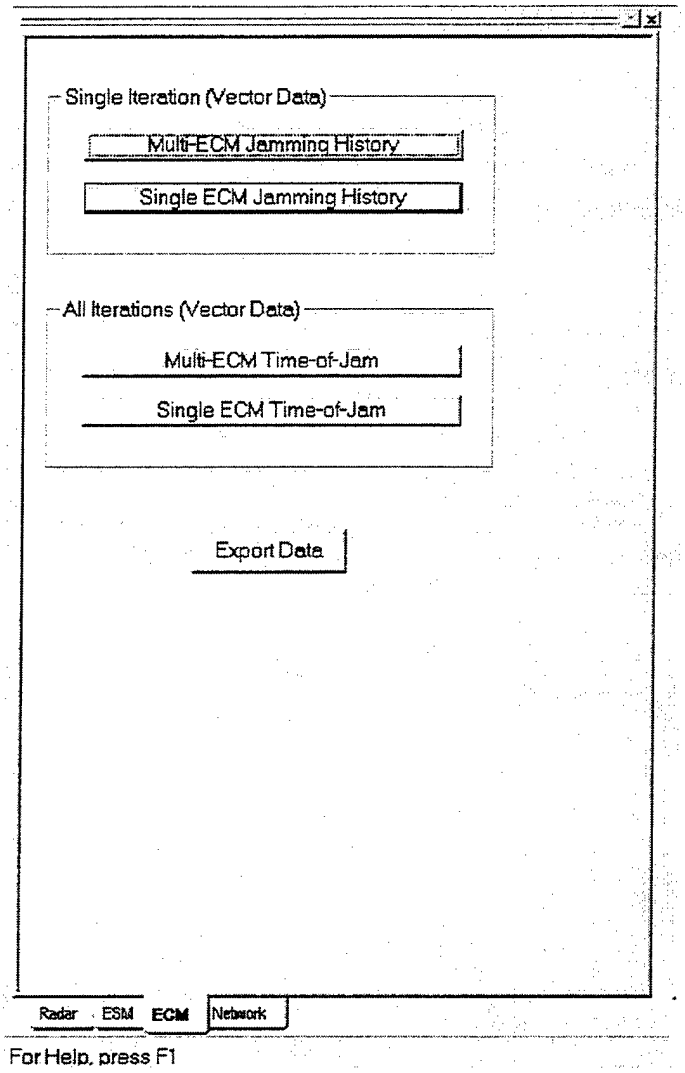

Figure 14-3. ECM Post-proc Control Bar

4. Network

This page, as shown in Figure 14-4, allows the users the option to select a network performance parameter for charting. These parameters must have been previously flagged on the Network Probes dialog from the Players tab for the selected player.

Single Iteration: Displays the selected performance parameter for a specified iteration.

- Tx Queue Delay: Presents dialogs for specifying a system, time interval, and iteration of interest. ARES then displays a chart in Chart view window illustrating the amount of time each packet spent waiting in a queue before transmission.

- Tx Packet Size by Priority: Presents dialogs for specifying a system, time interval, and iteration of interest. ARES then displays a chart in Chart view window illustrating the size of each packet transmitted, grouped by the priority of the packet.

- Tx Packet Size by Type: Presents dialogs for specifying a system, time interval, and iteration of interest. ARES then displays a chart in Chart view window illustrating the size of each packet transmitted, grouped by the type of packet.

- Tx Utilization: Presents dialogs for specifying a system, time interval, and iteration of interest. ARES then displays a chart in Chart view window illustrating a moving average of the percentage of time this player was in the process of transmitting a packet for each network.

- Rx End-to-End Delay by Priority: Presents dialogs for specifying a system, time interval, and iteration of interest. ARES then displays a chart in Chart view window illustrating the latency of each packet grouped by priority.

- Rx ETE Delay by Classification: Presents dialogs for specifying a system, time interval, and iteration of interest. ARES then displays a chart in Chart view window illustrating the latency of each packet grouped by the information contained in the packet.

- Rx Total Queue Delay by Priority: Presents dialogs for specifying a system, time interval, and iteration of interest. ARES then displays a chart in Chart view window illustrating the portion of the latency incurred in queues grouped by priority.

- Rx Utilization: Presents dialogs for specifying a system, time interval, and iteration of interest. ARES then displays a chart in Chart view window illustrating a moving average of the percentage of time this player was in the process of receiving a packet for each network.

- Rx Packet Size by Priority: Presents dialogs for specifying a system, time interval, and iteration of interest. ARES then displays a chart in Chart view window illustrating the size of each packet grouped by priority.

- Rx Packet Size by Type: Presents dialogs for specifying a system, time interval, and iteration of interest. ARES then displays a chart in Chart view window illustrating the size of each packet grouped by type.

All Iteration: Displays the selected performance parameter for all iterations specified in the Basic Runtime Control Bar.

- Tx Utilization by Network: Presents dialogs for specifying a player and time interval of interest. ARES then displays a chart in Chart view window illustrating the transmit utilization for each iteration grouped by network.

- Tx Average Queue Delay: Presents dialogs for specifying a player and time interval of interest. ARES then displays a chart in Chart view window illustrating the average queue delay for each iteration.

- Tx Max Queue Delay: Presents dialogs for specifying a player and time interval of interest. ARES then displays a chart in Chart view window illustrating the maximum queue delay for each iteration.

- Tx Max Queue Size: Presents dialogs for specifying a player and time interval of interest. ARES then displays a chart in Chart view window illustrating maximum queue size for each iteration.

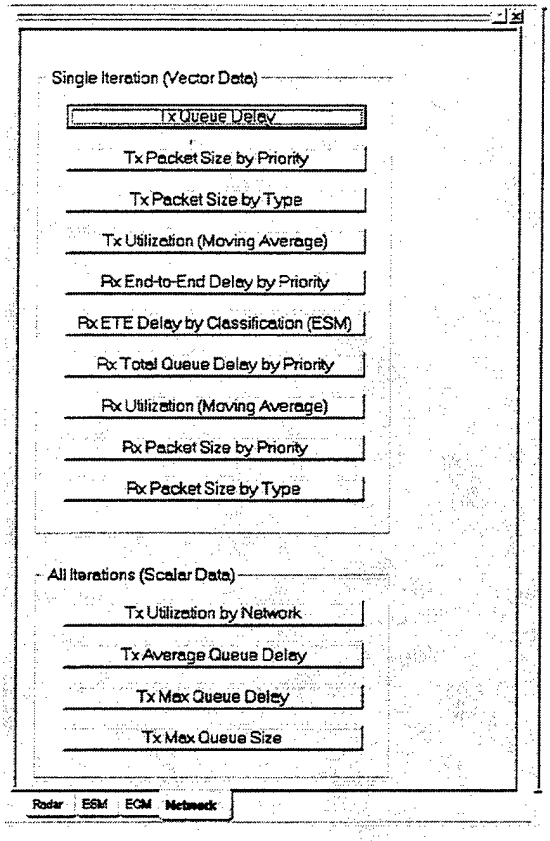

Figure 14-4. Network Post-proc Control Bar

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APPENDIX A. MULTI-BEAM RADAR EXAMPLE

This appendix presents a modeling example of a complex radar with multiple beams. For demonstration, Fan Song E is selected. The parameters for the radar are summarized in Table B-1. These parameters are basically obtained from Jane's database online at www.janesonline.com. Parameters that are needed but not given in the database are then either calculated or estimated. These are as shown on the ARES dialog samples (Figures B-1 through B-24). To test the model, a scenario was set up as shown Figure B-25 to determine the detection range. The simulation results are shown in Figure B-26 for 10 iterations with the end time of 3600 seconds.

Vertical antenna	
Frequency	5,010-5,090 MHz
Azimuth Beamwidth	7.5°
Elevation Beamwidth	1.5°
Scan Type	Vertical Sector
Scan Sector	7.5°/rev
Scan rate	15.5-17 rev/sec
Horizontal antenna	
Frequency	4,910 × 4,990 MHz
Azimuth Beamwidth	1.5°
Elevation Beamwidth	7.5°
Scan Type	Horizontal Sector
Scan Sector	7.5°/rev
Scan rate	15.5-17 rev/sec
Transmitter	
Peak power	1,500 kW
PRI	694 – 1200 μs
Pulse-width	0.4-1.2 ms
System Performance	
Unambiguous range	75-150 km/40.5-81 nmi

Table B-1. Fan Song E Parameters from Jane's Database

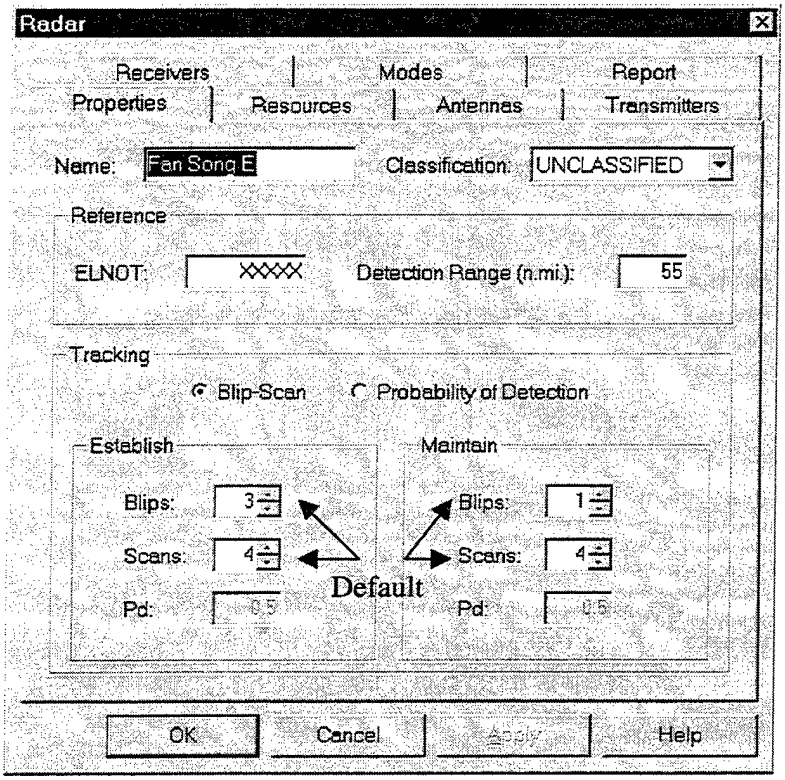

Figure B-1. Fan Song E Radar Properties Dialog

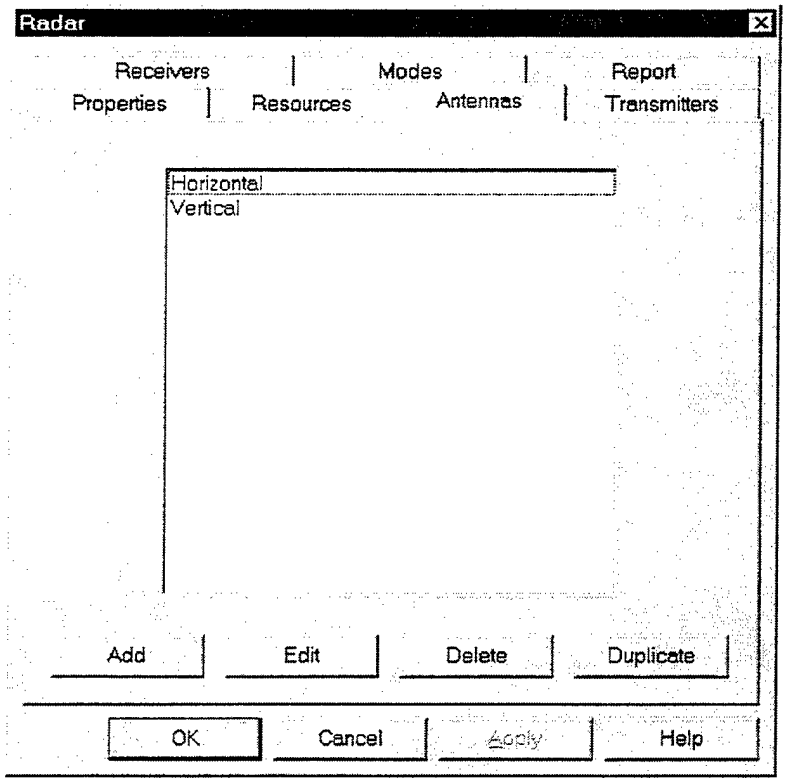

Figure B-2. Fan Song E Radar Antenna Dialog

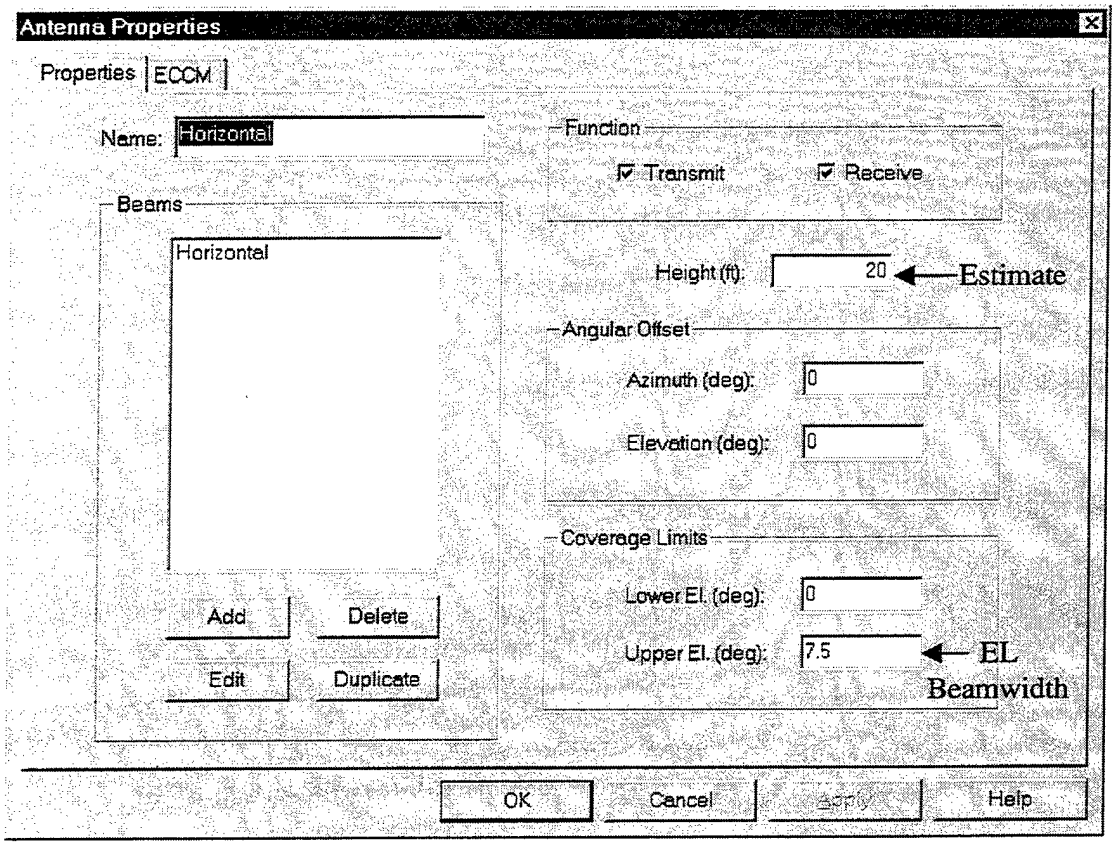

Figure B-3. Fan Song E Radar Horizontal Antenna Properties Dialog

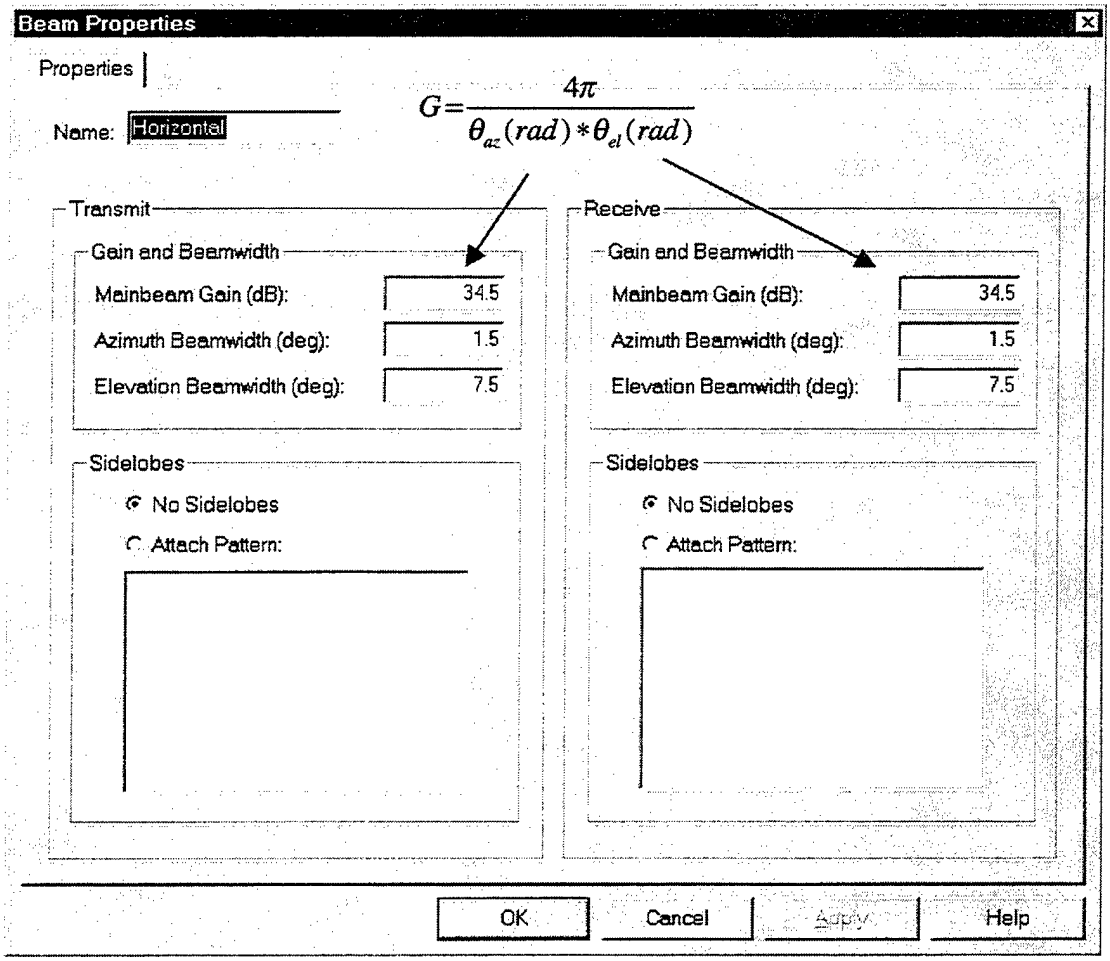

Figure B-4. Fan Song E Radar Horizontal Beam Properties Dialog

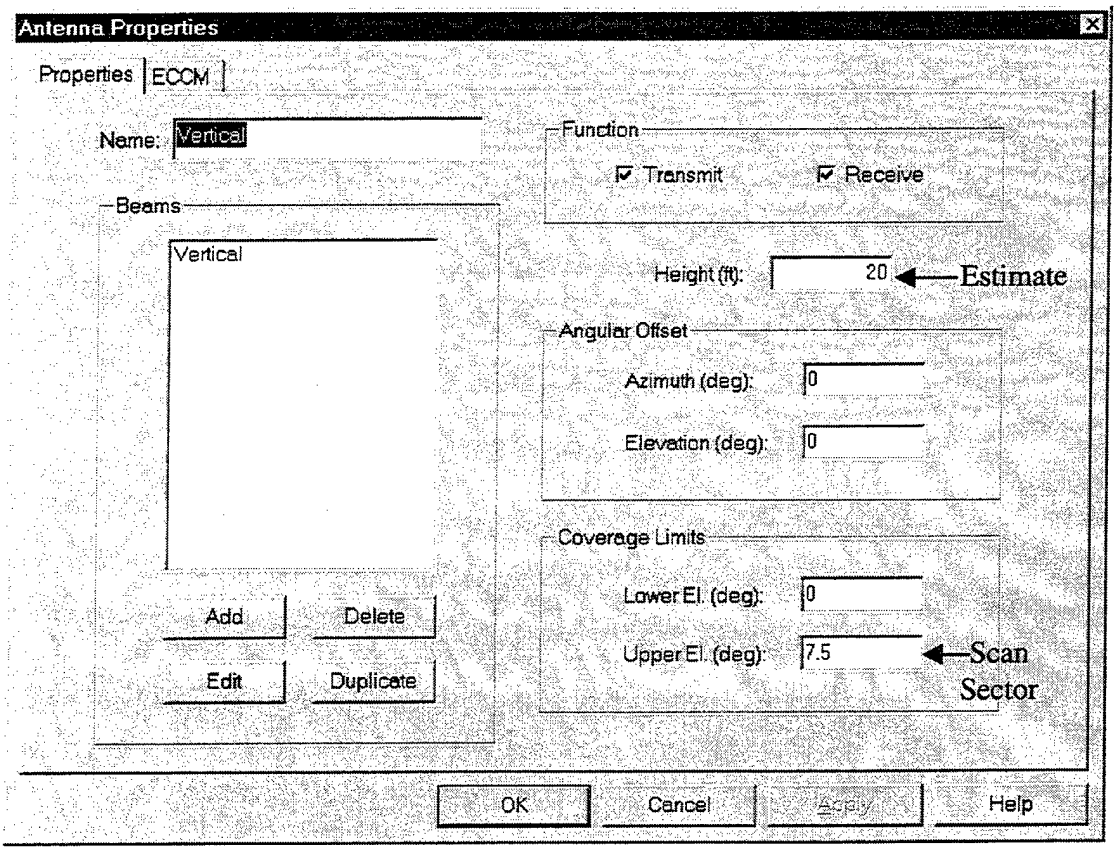

Figure B-5. Fan Song E Radar Vertical Antenna Properties Dialog

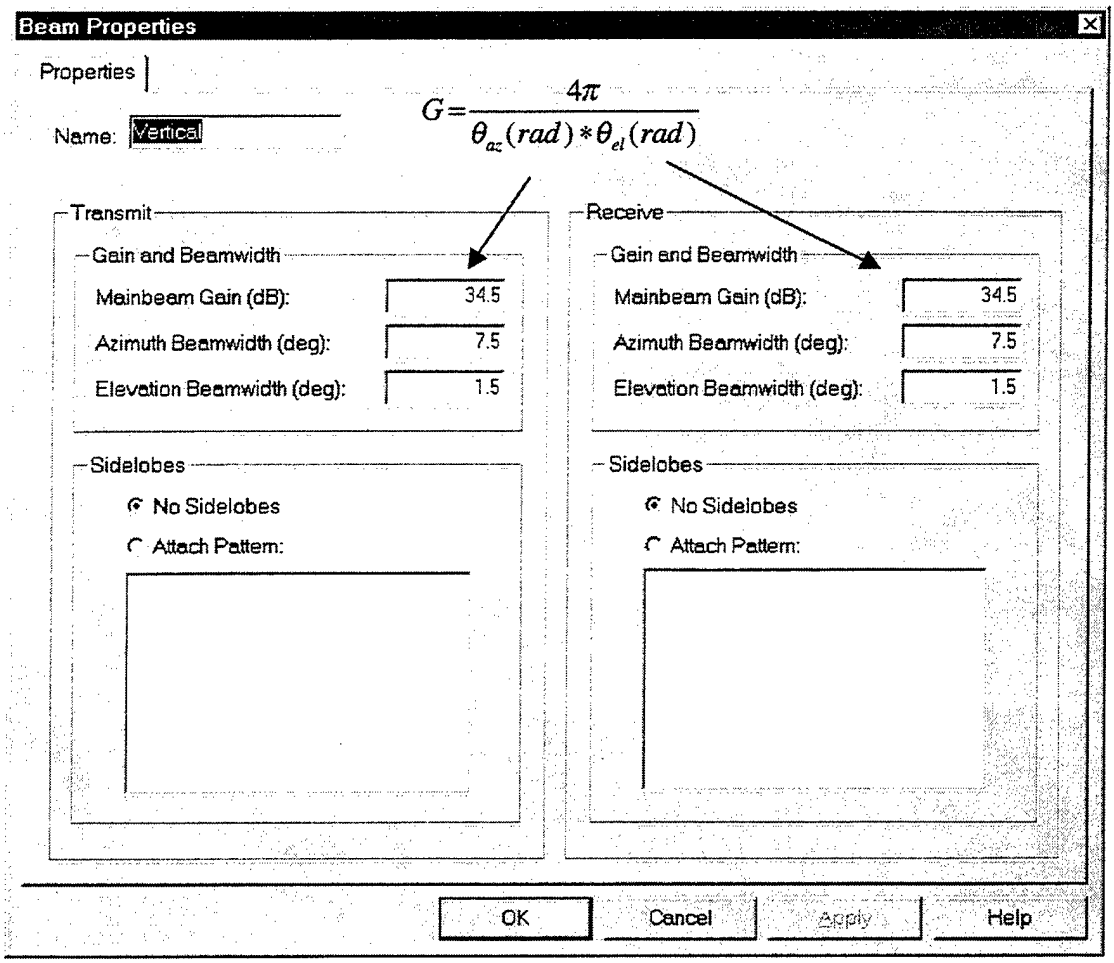

Figure B-6. Fan Song E Radar Vertical Beam Properties Dialog

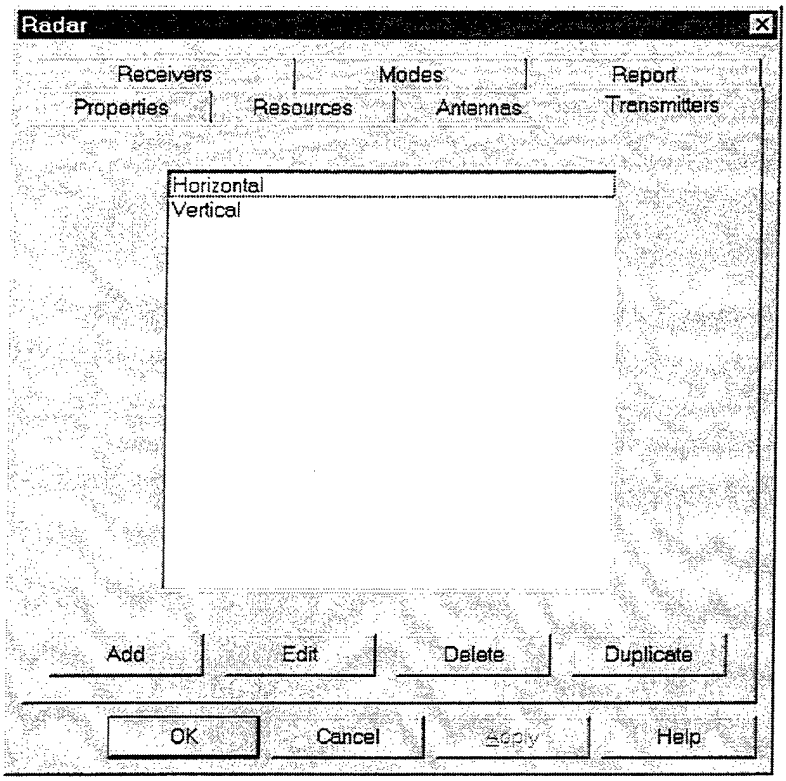

Figure B-7. Fan Song E Radar Transmitters Dialog

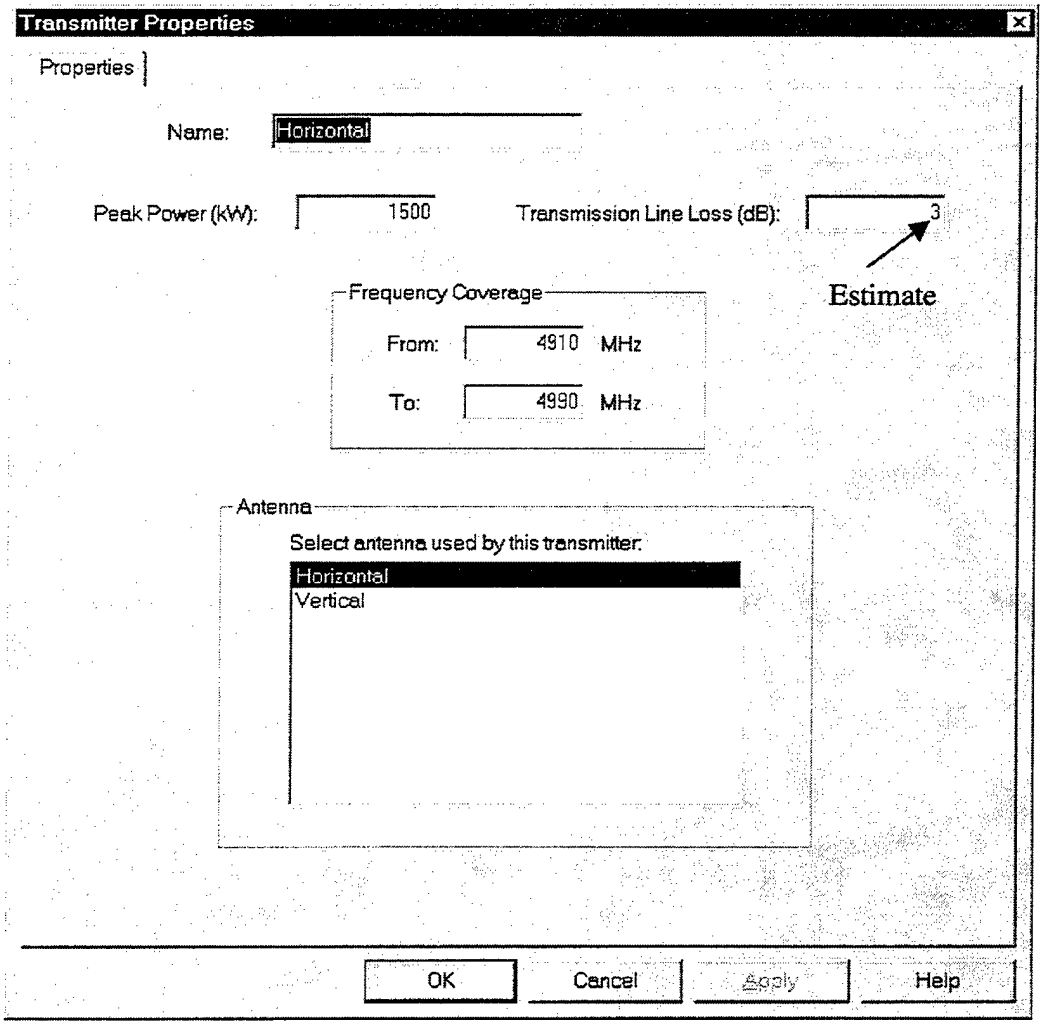

Figure B-8. Fan Song E Radar Horizontal Transmitter Properties Dialog

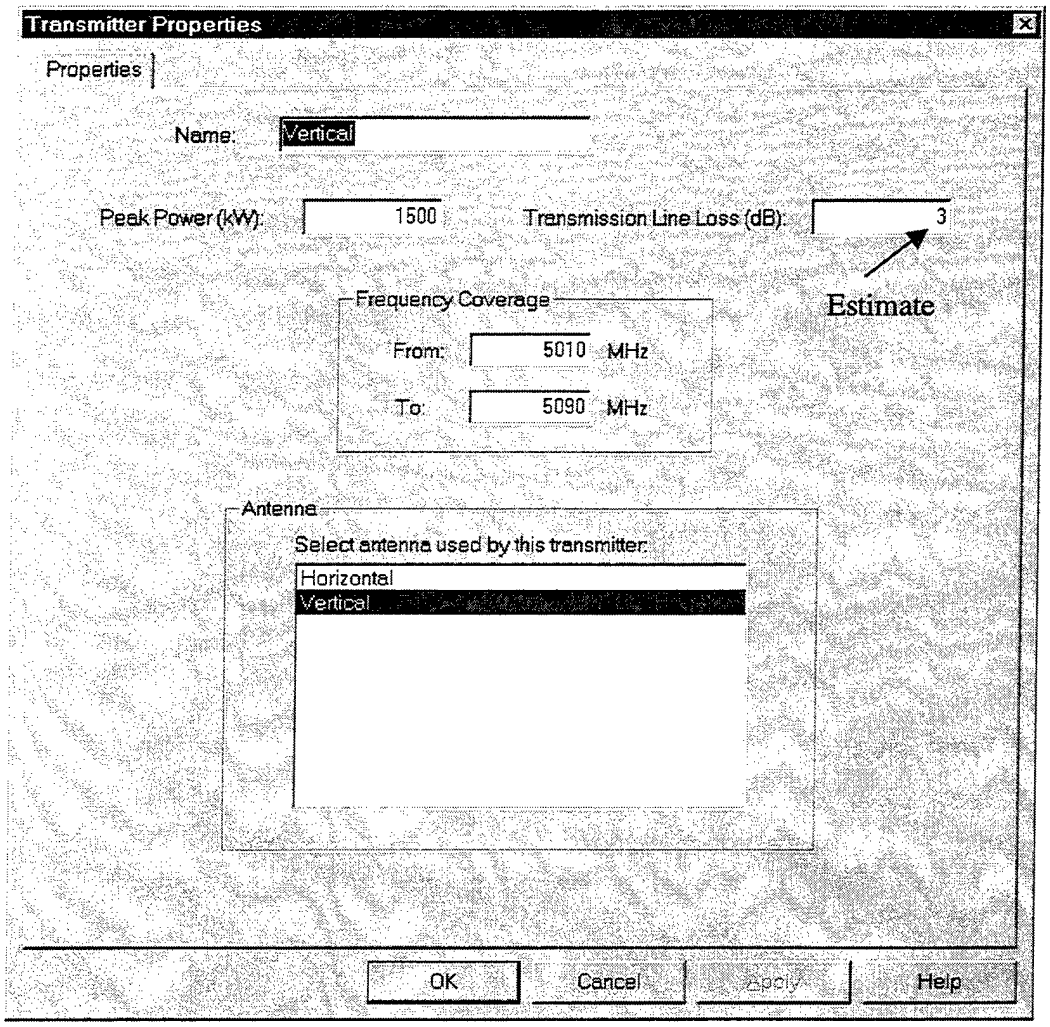

Figure B-9. Fan Song E Radar Vertical Transmitter Properties Dialog

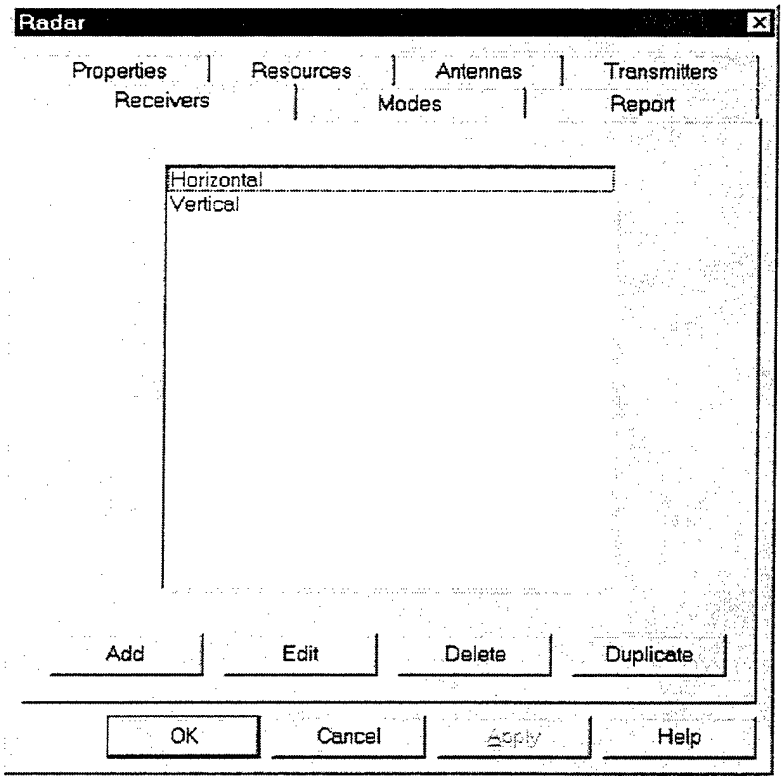

Figure B-10. Fan Song E Radar Receivers Dialog

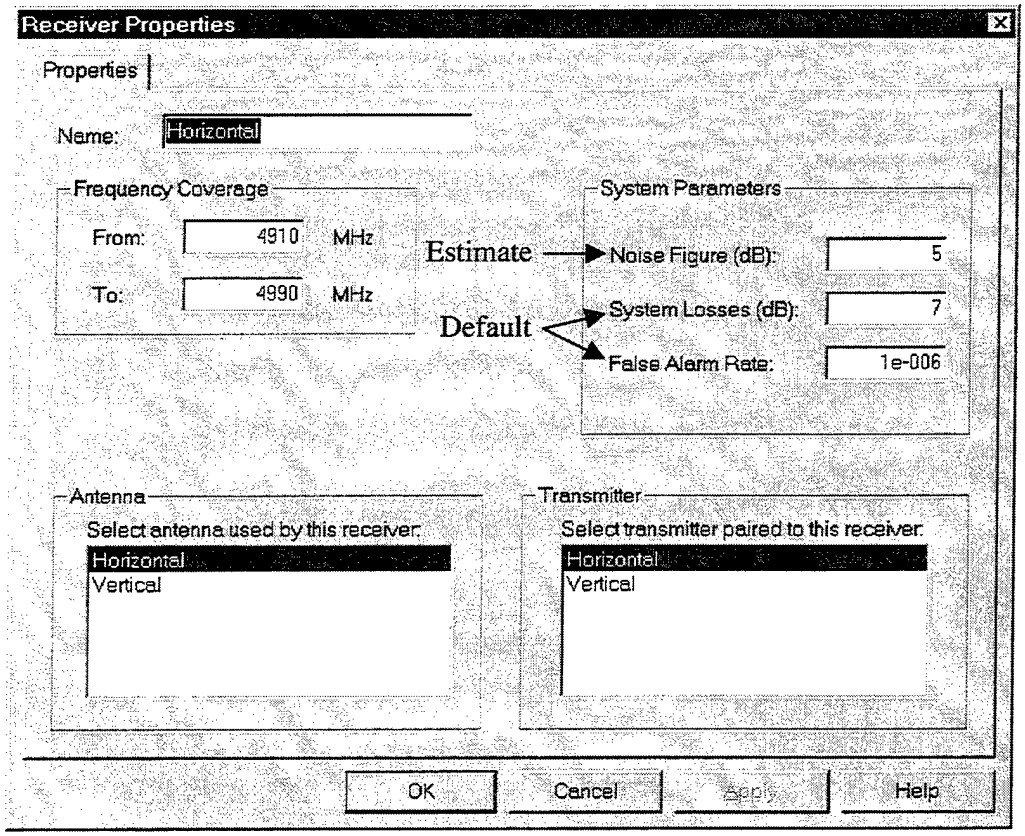

Figure B-11. Fan Song E Radar Horizontal Receiver Properties Dialog

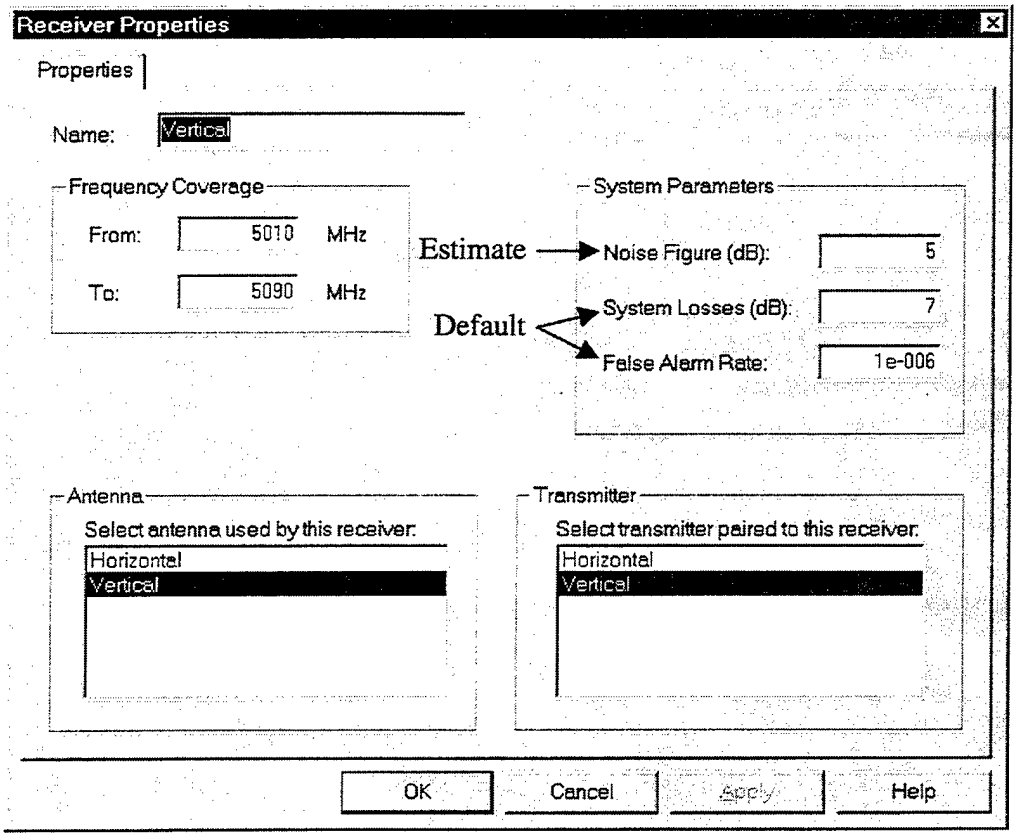

Figure B-12. Fan Song E Radar Vertical Receiver Properties Dialog

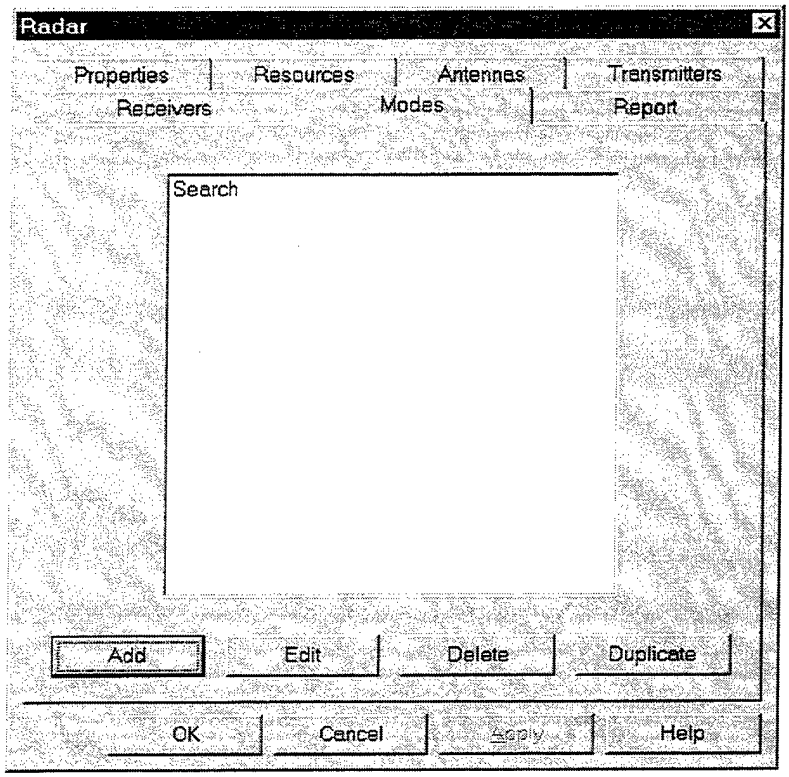

Figure B-13. Fan Song E Radar Modes Dialog

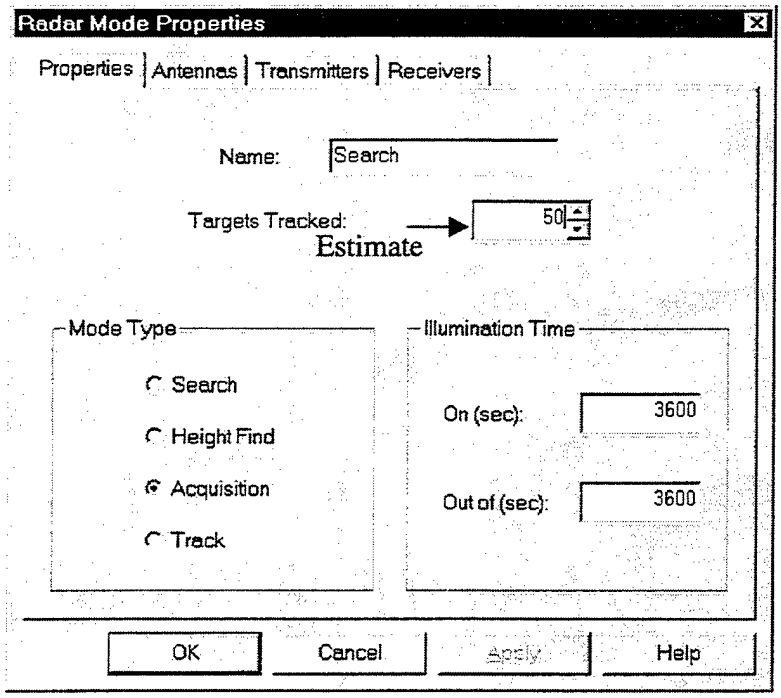

Figure B-14. Fan Song E Radar Mode Properties Dialog

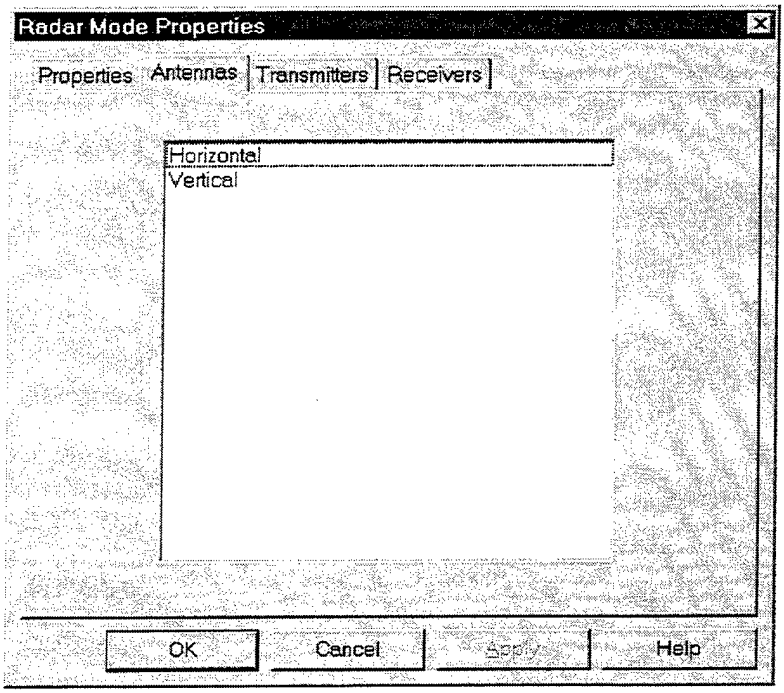

Figure B-15. Fan Song E Antennas-Radar Mode Properties Dialog

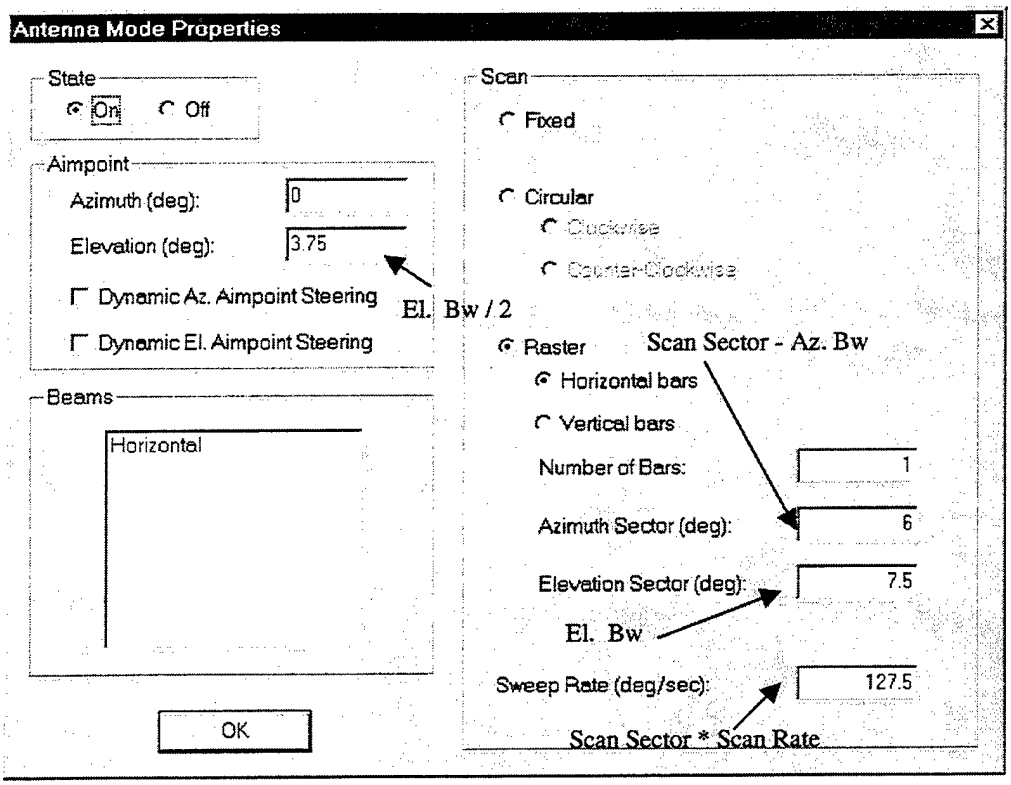

Figure B-16. Fan Song E Horizontal Antenna Mode Properties Dialog

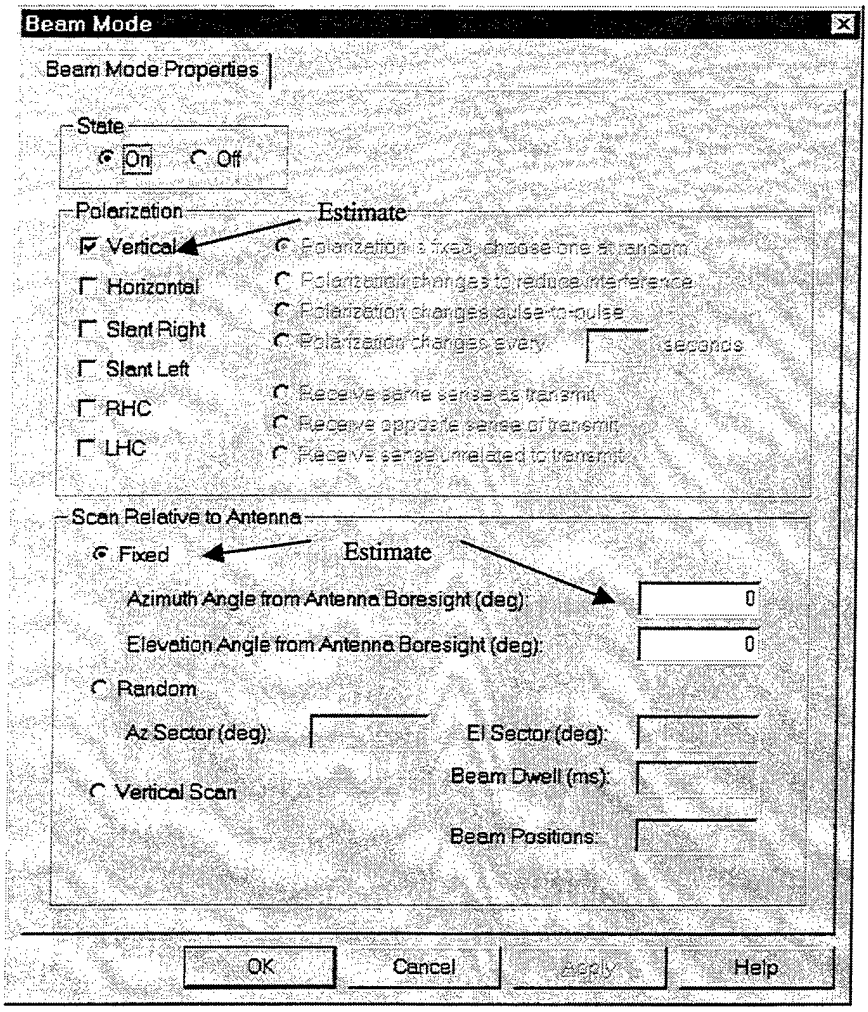

Figure B-17. Fan Song E Horizontal Beam Mode Dialog

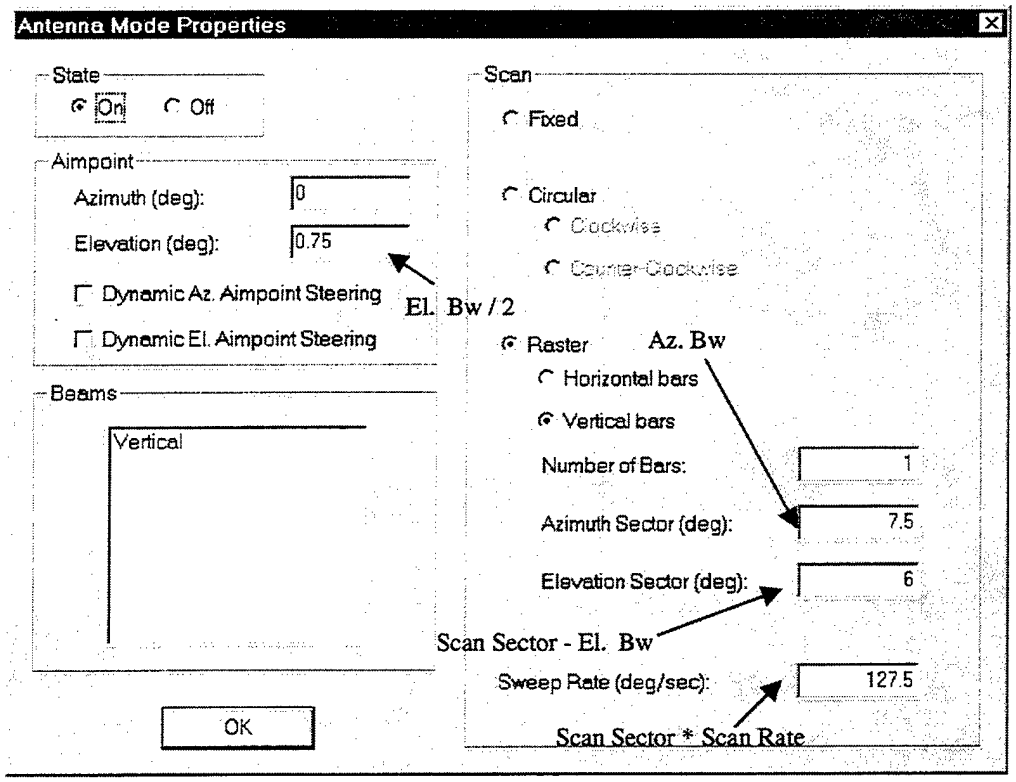

Figure B-18. Fan Song E Vertical Antenna Mode Properties Dialog

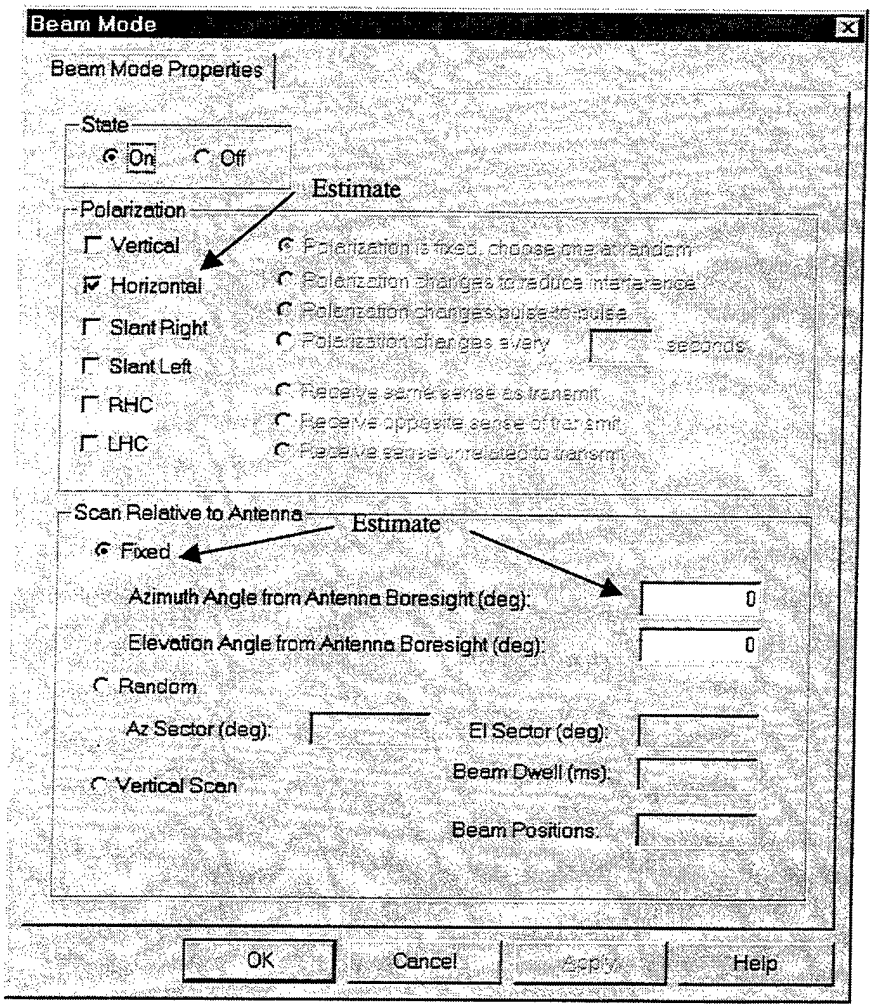

Figure B-19. Fan Song E Vertical Beam Mode Dialog

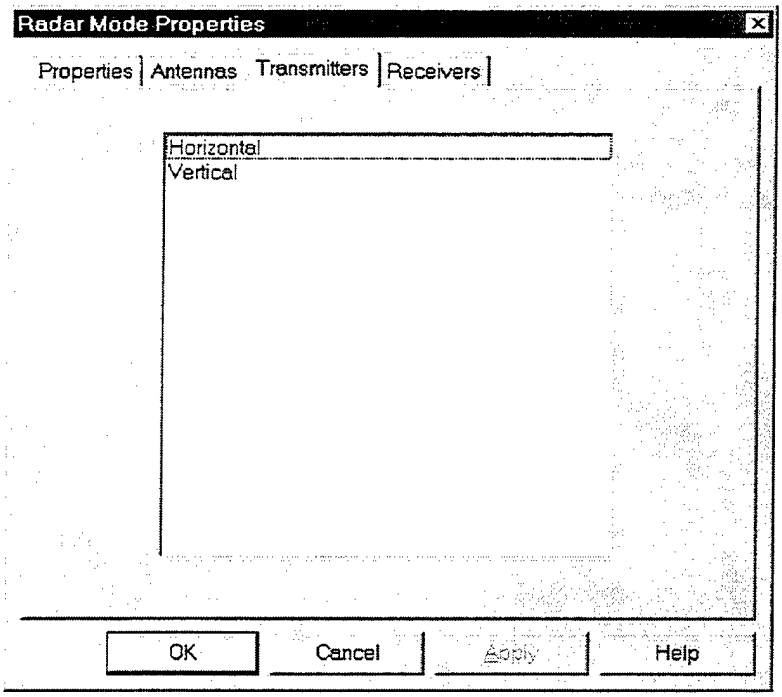

Figure B-20. Fan Song E Transmitters-Radar Mode Properties Dialog

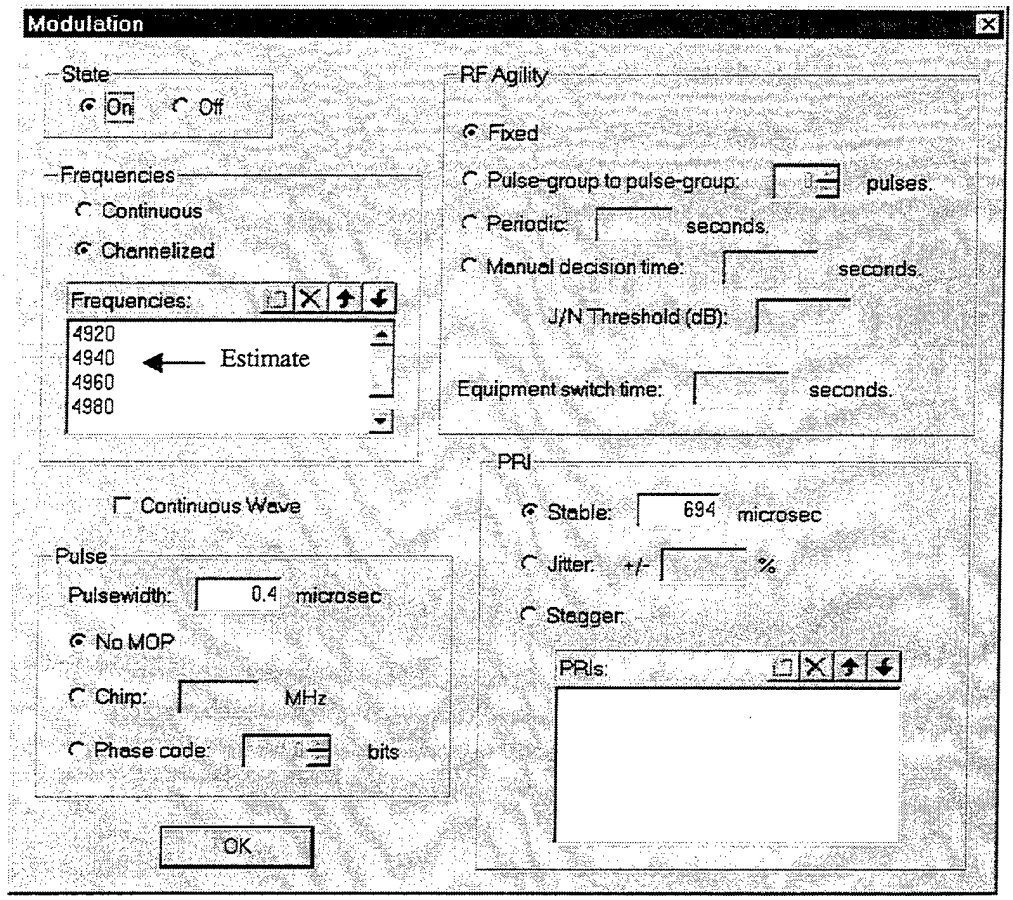

Figure B-21. Fan Song E Horizontal Modulation Dialog

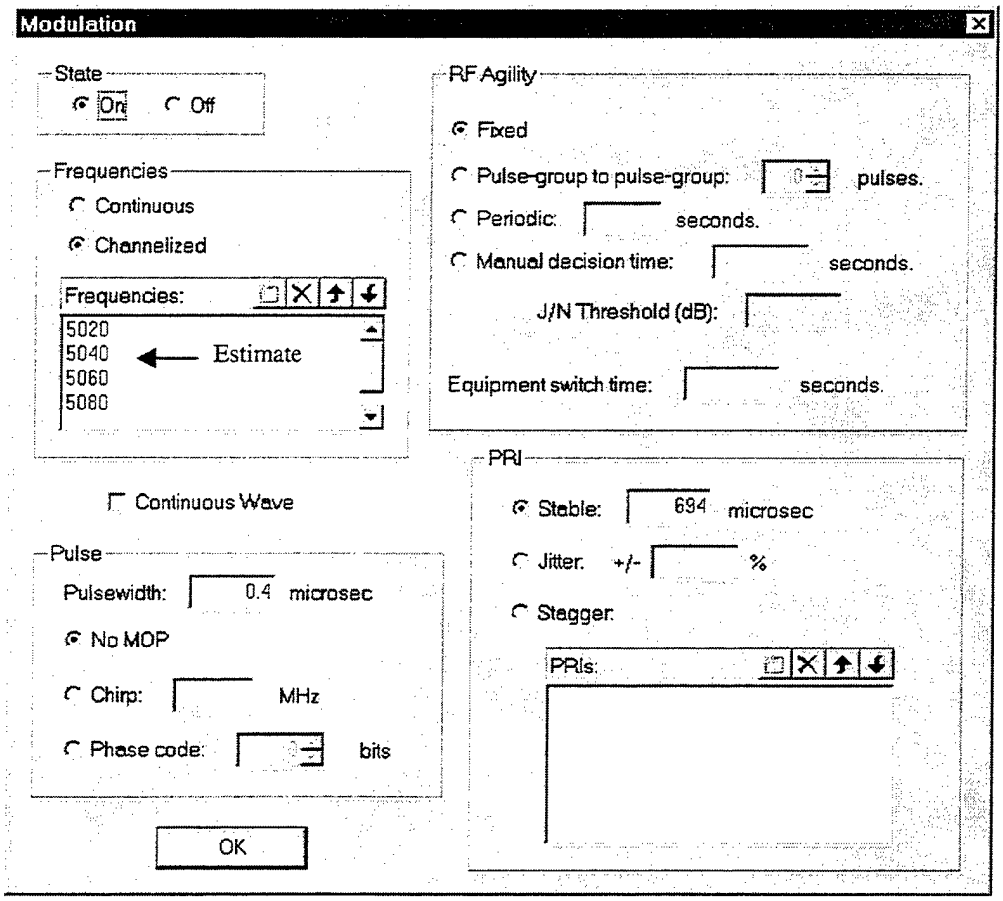

Figure B-22. Fan Song E Vertical Modulation Dialog

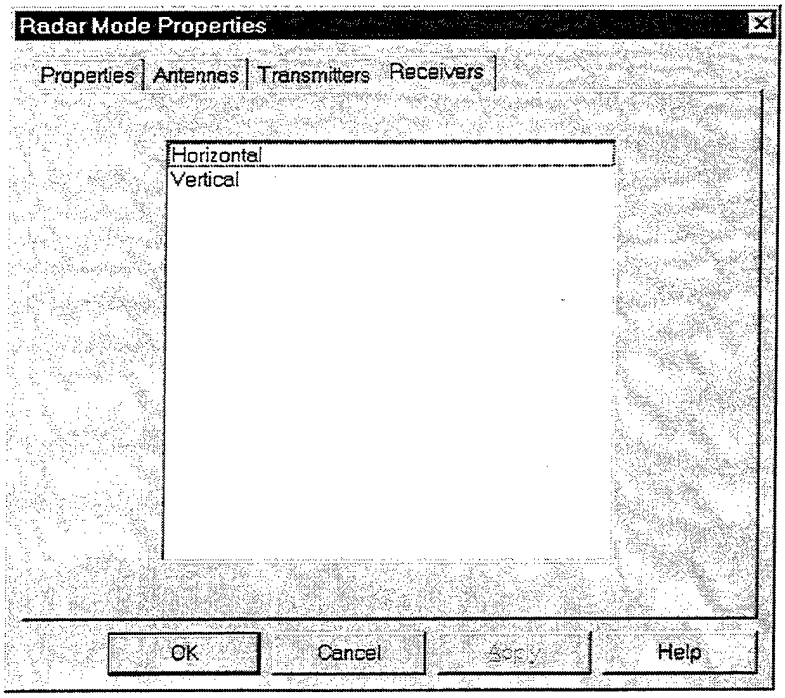

Figure B-23. Fan Song E Receivers-Radar Mode Properties Dialog

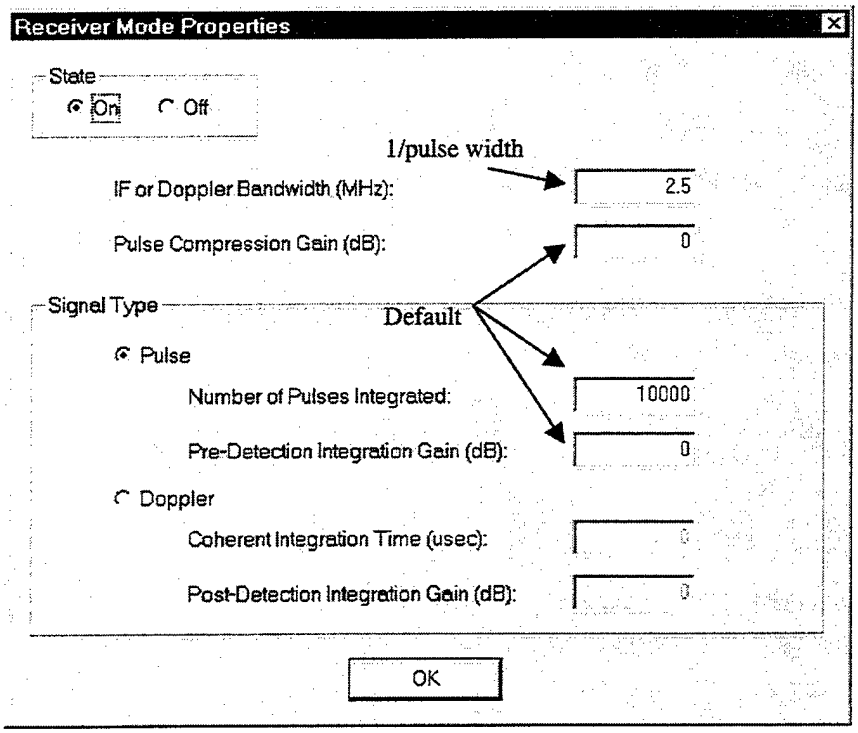

Figure B-24. Fan Song E Horizontal and Vertical Receiver Mode Properties Dialog

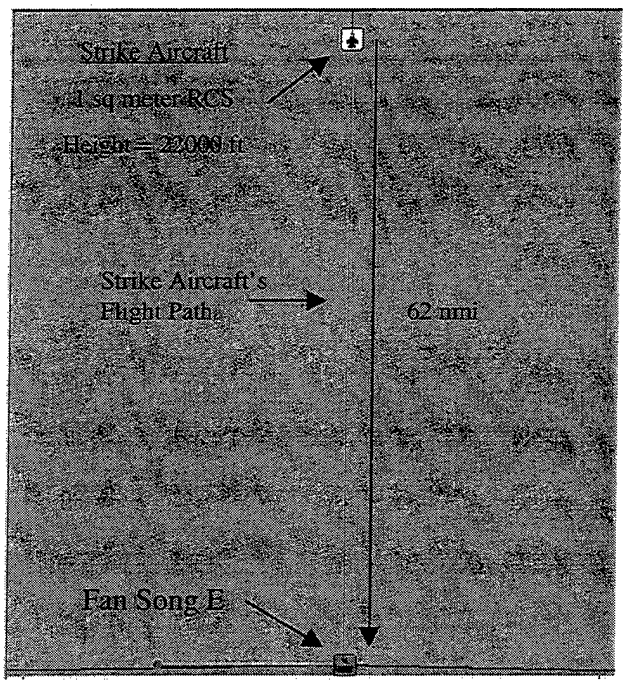

Figure B-25. Detection Range Simulation Scenario

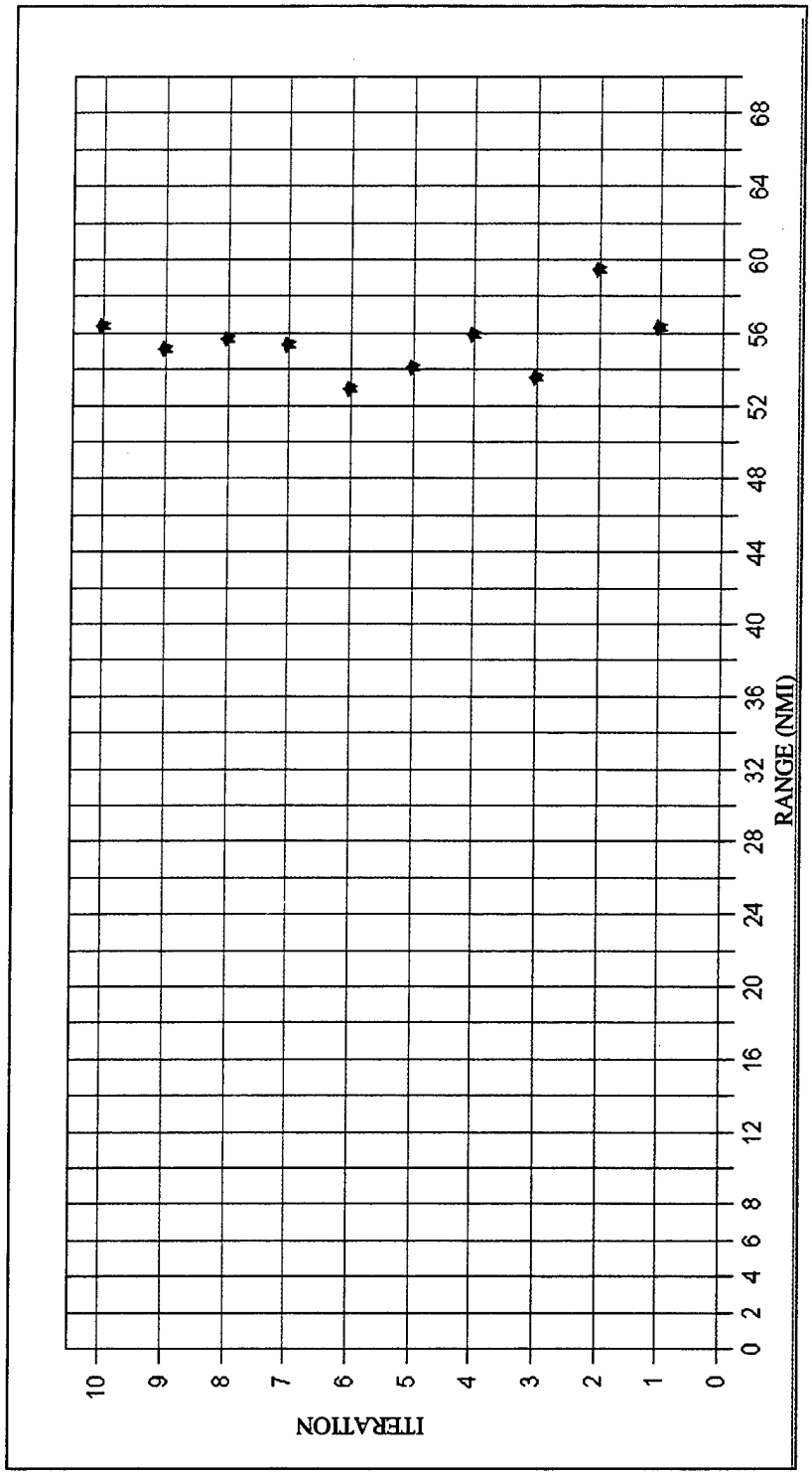

Figure B-26. Detection Range Simulation Results

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3. Naval Research Laboratory, ENEWS, Code 5705, *SIMDIS 6.2.8 The Advanced Analysis & Display Tool User's Guide*, 1 June 1999.

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